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MARCH

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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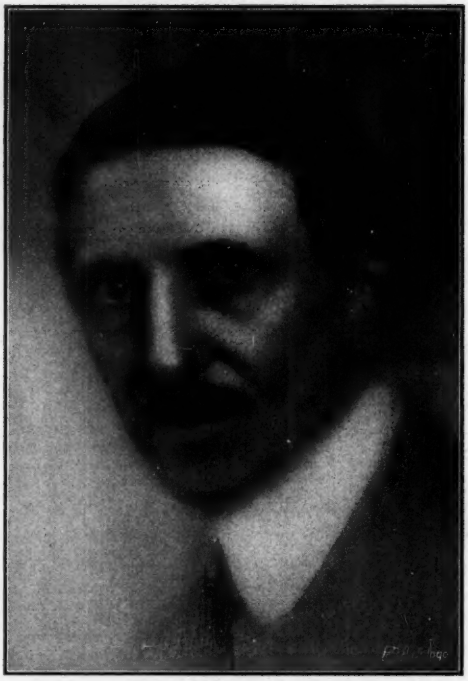

GEORGES VILLAIN, Paris, France
President, Eighth International Dental Congress

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Original Communications

PREGNANCY TUMORS: A STUDY OF SIXTEEN CASES*

By THEODOR BLUM, D.D.S., M.D., F.A.C.D., F.A.C.S., New York City

IT was during my postgraduate studies in Berlin in 1912 that I first heard the term "pregnancy tumor." Since then, a larger number of cases than reported here have come under my observation, but only fourteen, between the years 1919 and 1930, inclusive, could be collected and were found suitable for this study. Just before the completion of this paper, Cases 15 and 16 were seen, and they will be discussed below, although they are not included in the general study of the other fourteen.

A pathologic examination of all these masses showed that only three (11, 12 and 13) were giant-cell tumors, one (14) hypertrophy of the gum tissue, while, for the remaining ten, I should like to reserve the term "pregnancy tumor," a pathologic report of which, with photomicrographs, prepared by Dr. Furedi, director of my medical laboratory, will follow later on. Whether internal secretion plays a part in their development has not been definitely proved. The ages of the patients range from 18 to 39, giving an average of 27. Of these, six occurred during the first pregnancy, two during the second and three during the third. In two cases, this information is missing, and in one, the case of hypertrophy (14), the onset was before pregnancy. With the exception of the cases showing recurrence and the six-year case (9), the average duration of the tumor was three and twenty-seven hundredths months. In three cases, the recurrence took place in the next pregnancy; in one case, the tumor recurred without the patient's being pregnant. Only in one were there recurrences in subsequent pregnancies. The growth appeared in one case during the second month of pregnancy; in two cases during the third month; in one case during the fourth month; in three cases during the

*Read before the American Society of Oral Surgeons and Exodontists, Evergreen, Colo., July 18, 1930.

fifth month; in one case during the sixth month, and in two during the seventh month. On the remaining cases, this information is not available. Five cases continued after pregnancy while in three, there was a spontaneous disappearance after childbirth. In one of these, the growth disappeared two months after childbirth, but in every case there was a recurrence in the next pregnancy. The growth showed a predilection for the maxilla, where eleven were located. There was one in the mandible and one (hypertrophy) in both the mandible and maxilla, and the last one occurred on the mucous surface of the lower lip, the only tumor not growing from the gingiva. No

Fig. 1 (Case 4).—Separation on the left side of the upper left incisors, where the pregnancy tumor was situated. The roentgenogram is otherwise negative.

other such case has been recorded in the literature as having appeared during pregnancy. Eight cases, only one of which was in the mandible, were in the region of the central and lateral incisors and the cuspid; two, in the region of the cuspid, first and second bicuspids, and two in that of the third molar. Five were mainly on the palatal side. The average size of the tumor was 1.1 cm. in diameter. It was not pain that made these patients look for relief, as only two complained of slight pain and only one experienced much (hypertrophy). Bleeding was present in ten cases.

Macroscopically, the mass appeared pinkish, reddish or bluish where mucous membrane was covering it, while the ulcerated part either showed a raw bleeding surface or was covered with a grayish membrane. It was often pedunculated and the mass itself of different shape, flattened out at times like a mushroom, or lobulated. On palpation, they were usually firm, but also soft and flabby. Palpation of these tissues would often cause bleeding. The small tumors always were attached to the gingival pyramid. The roentgenologic findings, when the roentgen rays were available, were entirely negative except for one case (13) in which the peridental lamella and the spongiosa were destroyed and seven cases in which the adjacent teeth were separated. Four roentgenograms were entirely negative.

A typical roentgen-ray picture (4) is seen in Figure 1. The peridental lamella and spongiosa between the upper left and upper right incisors are practically identical except for the separation on the affected side, namely, the left. In Figure 2, roentgenograms of Case 5, the tumor was situated between the lower left lateral incisor and cuspid. Some of the alveolar process has been lost, but the same loss can be seen in the adjacent teeth and was also evident on the opposite side, which may have been due to some pericemental condition involving the whole mouth. Figure 3 illustrates Case 10, in which the most marked separation of all cases is seen between the upper left incisors, but here also is a rather definite absorption of the alveolar process throughout, and, to my mind, it had nothing to do with the formation of the neoplasm. Here, the irritation of food pressing ever so often on the soft tissues between these

two teeth is quite a plausible etiologic factor.

For differential diagnosis, it may be of interest to show the roentgenograms (Fig. 4) of a young woman, aged 20 (single), not belonging to the group of cases recorded here, who had a small tumor on the labial side between the lower left lateral incisor and cuspid which was diagnosed microscopically as an osteofibroma. Here, we see no separation but a marked loss of bone and the pericemental lamella at the upper half on the distal side of the root of the lower left lateral incisor.

The roentgenograms of Case 13, a beginning giant cell tumor (Fig. 5) show marked destruction of the pericemental lamella and spongiosa, as well as separation of the central incisors between which the tumor occurred. The whole appearance is fairly typical of a peripheral giant-cell tumor. This tumor had recurred and had been cut many times.

For comparison, it may not be out of place to show the roentgenograms (Fig. 6) of a peripheral giant-cell tumor in a man, situated in the region of the lower incisors in a case which gave a history of injury. The destruction of bone is indeed very similar, although the tumor itself is more extensive.

The etiology of these tumors is obscure. In two cases, trauma may have played some part because teeth had been removed in that region. Another possibility is the

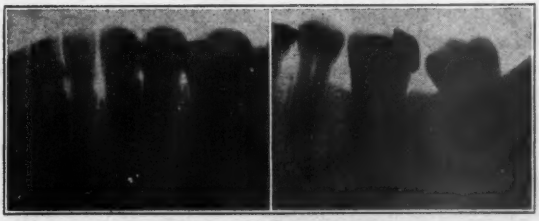

Fig. 2 (Case 5).—Pregnancy tumor between the lower left lateral incisor and cuspid. The slight absorption of the alveolar process can be seen in the adjacent teeth and also on the opposite side.

Fig. 3 (Case 10).—Pregnancy tumor between the upper left incisors, with very marked separation between these two teeth. Definite absorption of the alveolar process can be seen throughout.

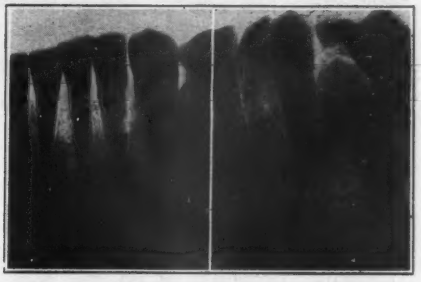

Fig. 4.—Osteofibroma between the lower left lateral incisor and cuspid. There is loss of bone and pericemental lamella.

irritation and trauma of the gingival pyramid at a time when the internal secretions, on account of the pregnant condition, may not have been normally balanced and when the hygienic care of the mouth may have been neglected. Whether or not the hygienic condition of the mouth plays an important rôle it is difficult to say. It may be well to state at this point that, in a number of cases, both the teeth and the soft tissues were in perfect condition.

From a pathologic standpoint, the pregnancy tumors, with the exception of the diffuse one, belong to the so-called epulides. The term "epulis" does not give any real pathologic diagnosis, indicating only that the location of these tumorlike formations is on the gum. After the newest theory of Rywkind,[1] there are three different types of epulides; namely, the simple granuloma, the angiogranuloma and the giant-cell granuloma. In his opinion, the two former are really products of chronic inflammation of the gingiva or the periosteum and the difference is due only to the maturity of the process. The third, the giant-cell epulis, is a reactive proliferative process originating from the deeper portions of the peridental membrane or from the spongiosa of the alveolar bone.

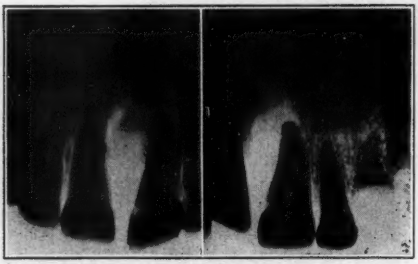

Fig. 5 (Case 13). — Peripheral giant-cell tumor between the central incisors. There is marked destruction of the spongiosa and of the pericemental lamella.

In the study of our fourteen cases, we noticed the following: In ten, the microscopic picture was quite similar, namely, that of the angiogranuloma of Rywkind, or vascular epulis, according to the usual nomenclature. The difference which really exists between the pregnancy tumor and the foregoing will be mentioned later. Three have the characteristic picture of a giant-cell epulis; one of them, which had been elsewhere diagnosed as osteofibroma, is not fully developed, but distinct giant-cell formations are visible, even though only in moderate numbers, within a very cellular stroma. The diffuse swelling of the gingiva in Case 14 microscopically revealed the structure of the so-called gingivitis hypertrophica, which really shows a marked resemblance to the epulis of the first and second type.

The closer study of the ten former cases revealed to us interesting facts of such practical value that a more detailed description seems indicated.

The first and second pictures (Figs. 7 and 8) show the general appearance of these tumors, one attached to the free gingiva, the other, to the lip. We can see how the tumor mass protrudes from the edge of the normal gingiva. The stratified epithelial covering suddenly stops and the whole surface of the tumor is ulcerated and covered with a necrotic mass. The last portion of the epithelium is here somewhat proliferated, owing to the inflammation which will be mentioned later. We can notice already in these pictures that the whole mass of the tumor is really made up of numerous, mostly engorged, blood vessels. We can also see that the tumor extends much

1. Rywkind, A. W.: Virchow's Arch. f. path. Anat., 263:415, 1927.

deeper than a cursory examination would lead one to believe.

The third picture (Fig. 9) is taken from the region of a blood vessel lying in a part of the specimen which otherwise appeared to be quite normal. Here, we can see the origin and real nature of this kind of tumor. One large capillary and numerous small capillaries are present, the space between them being filled with cells, the so-called perithelial cells normally covering the endothelial lining of the capillaries. They show here a very active proliferation. Some of the newly formed cells remain on the vessel wall, others invade the neighboring tissue, producing a picture as shown in Figure 10. This photograph was taken from the deepest portion of the second section (Fig. 8). Here, we see the bulk of the perithelial cells in which the capillaries are embedded. At this stage, the picture is the same as in the so-called perithelioma. The cells are quite undifferentiated mesenchymatous, showing numerous mitotic figures, the sign of an active proliferation. Furthermore, a certain glandular arrangement, noticeable in all the young portions, is very interesting.

Figure 11 shows the structure of the fully developed portion, composed of smaller and larger capillaries lined with one layer of endothelial cells and usually filled with red corpuscles and some blood serum. Occasionally, a thin loose meshwork is noticeable between them. Sometimes the vessels show cavernous enlargement, as seen in Figure 12, where they are filled with serum. This abundance of blood vessels explains the tendency to bleeding, present in almost all of the cases. In the whole tumor mass, there is no sign of inflammation, except toward the ulcerated surface, where inflammatory cells appear. They are predominant just below the ulcerated surface, as shown in Figure 13, taken from the same case as Figures 10 and 11. This fact permits us to suppose that, in these tumors, the inflammatory process is only superimposed. The swollen, elevated gingiva is very readily injured, desquamation of the surface epithelium takes place and epithelial defect and ulceration develops, giving a *locus minoris resistentiae* for bacterial invasion. According to this general description, the pregnancy tumor usually does not contain the three different portions of an epulis, namely, the granulomatous, the vascular and the fibrous portion.

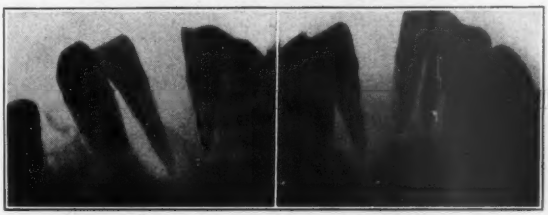

Fig. 6.—Peripheral giant-cell tumor situated in the region of the lower incisors. There is marked destruction of bone.

The microscopic picture (Fig. 14) of the case of gingivitis hypertrophica reveals a marked resemblance to those mentioned before, but here are portions in the specimen which show a marked fibrous nature (Fig. 15), although blood vessels are quite numerous.

Fig. 7.—Pregnancy tumor attached to free gingiva.

Fig. 8.—Pregnancy tumor attached to lip.

Fig. 9.—Active proliferation of the perithelial cells.

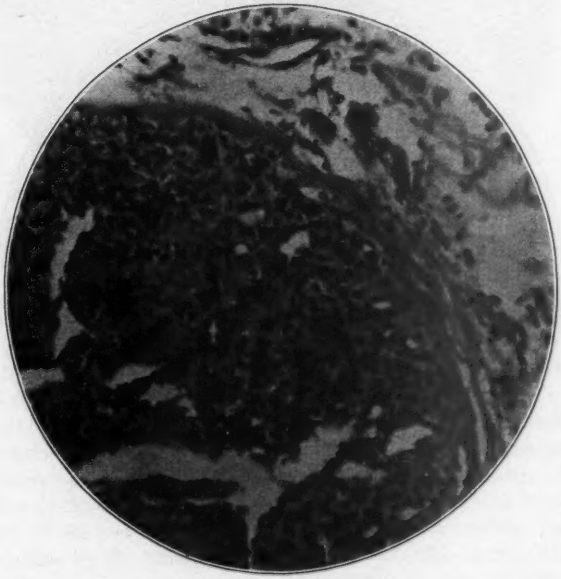

Fig. 10.—Perithelioma-like formation (taken from Figure 8).

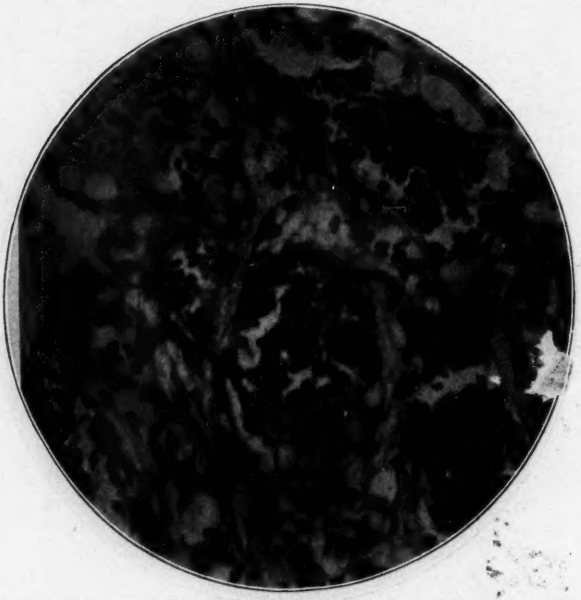

Fig. 11.—Structure of the fully developed portion (no inflammation).

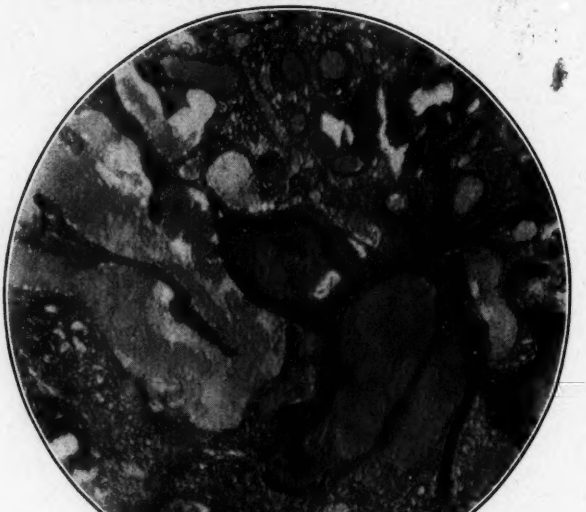

Fig. 12.—Cavernous enlargement of the blood vessels.

The other three cases were of the giant-cell epulis type, of one of which we said before that only a scanty number of giant cells are present. The other two are fully developed tumors with numerous giant cells, without any atypical changes of the nuclei of the giant cells nor of the spindle cells of the stroma. Figure 16 shows, under low power, a tumor with two teeth (the apex of one was broken at the time of the operation)

Although these cases were selected because, with the exception of one, they began during pregnancy, we see that the microscopic examination revealed two distinctly different groups among them, which makes an etiologic explanation certainly very difficult. It has long been known that epulides very often arise during pregnancy, but whether pregnancy constitutes an etiologic factor or only predisposes is undecided. It is also a

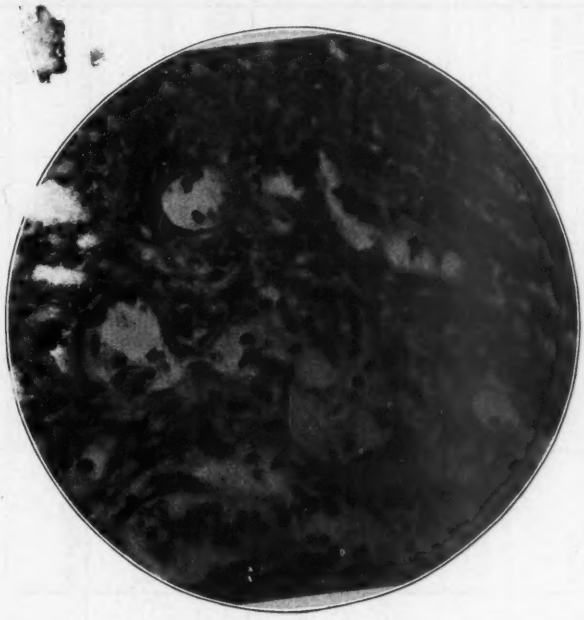

Fig. 13.—Portion beneath the ulcerated surface; marked inflammatory infiltration.

and the alveolar process. We can see the peripheral location of the tumor mass and its extension alongside and between the teeth. The greater portion of the peridental lamella having been destroyed, slight absorption of the cementum is present at the side of the teeth. Figure 17 shows the structure of the tumor under higher power.

known fact that many pathologic changes in the mouth show certain connections with the endocrine balance, or rather with a disturbance of the endocrine balance of the whole body. Retention of teeth in case of thymus hypoplasia, periodical gingivitis during the menstrual periods or compensatory bleeding from the gingiva in case of pathologic meno-

DATA ON SIXTEEN CASES

Case	Macroscopic Appearance	Pain	Bleeding	Peridental Lamella; Bone (Spongiosa); Teeth	Blood*	Urine	Operation	Former Pathologic Report
1	0.5 cm., red, triangular		Readily	Neg. except for slight separation of upper left cusp. and 1st. bicusp.	9,700 leukocytes (74% polymorphonuclear, 25% lymphocytes)	Albumin, faint trace, occas. renal cells	Tumor and periosteum	
2	0.5 cm. diam., 0.25 cm. thick, partly ulcerated			Separation, upper right lat. inc. and cusp.			Conservative, tumor, and cautery	
3	1.5 cm. diam., mushroom shaped, dark red			Neg. except separation of upper right 2d. and 3d. molars			Tumor and bone and upper left 3d. mol.; Buccal root of which appeared denuded	
4	0.5 cm., labial, reddish, 0.75 cm., palatal, pale blue, pedunculated, palatal		On brushing	Neg. except separation of upper left incisors	Anemic condition; 11,600 leukocytes (82% poly., 10% lymp.)	Negative	Tumor, conservative, and cautery	
5	0.25 cm. in diam., papular, hemorrhagic, pedunculated below		On brushing		11,150 leukocytes 94% poly., 6% lymph.	Negative	Conservative, tumor and small bone and periosteum	Soft fibroma
6	2 cm. long, 1.5 cm. high, pedunculated, dark red		On pressure		27,600 leukocytes (64% poly., 36% lymp.)	Sugar, trace	Tumor and bone and upper right bicuspids (roots badly exposed	Hemangioma
7	1 cm. in diam., slightly ulcerated, pedunculated		On eating	No x-ray exam., neg. except separation of upper incisors			Conservative, tumor, and cautery	Fibroid, undergoing subacute inflam. process
8	1 cm. side to side, 0.5 cm. ant. post., slightly pedunculated, ulcerated, grayish, some reddish areas		On touching		Moderately anemic condition, 9800 leukocytes (81% poly., 13% lymp.)	Negative	Tumor	

DATA ON SIXTEEN CASES—CONTINUED

Case	Macroscopic Appearance	Pain	Bleeding	Peridental Lamella; Bone (Spongiosa); Teeth	Blood*	Urine	Operation	Former Pathologic Report
9	0.5 cm. in diam., irregular, reddish blue, pyramid	Occasional slight		Upper right lat. good filling on distal side			Conservative, tumor, and cautery	No specimen
10	2 cm., lobulated pinkish pedunculated		Slightly	Negative except marked separation of upper left incisors	14,300 leukocytes (79% poly., 20% lymp.)	Albumin, faint trace, occas. casts, renal cells	Tumor, bone and upper left incisors and cuspid	
11	Ulcerated spongy	Slightly sore on touching	On palpation		7,640 leukocytes (69% poly., 30% lymp.)	Albumin, faint trace	Tumor, bone and upper left 2d. mol.	Giant cell
12	2.5 by 4 by 1 cm., reddish brown, pedunculated, lower surface ulcerated			No x-ray exam.	10,900 leukocytes (65% poly., 33% lymp.)	Albumin, marked, few renal cells	Tumor, bone and teeth	
13	1 cm. long, red lobulated		Only in parts	Periden. lamella and bone destroyed; upper incisors separated	11,200 leukocytes (79% poly., 19% lymp.)	Albumin, marked trace, few casts, few renal cells	Tumor, bone and teeth	Osteofibroma
14	Hypertrophied and severely congested gums	Very painful	On eating, touching		12,000 leukocytes (71% polyn., 17% lymp.)	Negative	Tumor, bone and teeth	Hypertrophy of gums due to fibrous tissue hyperplasia
15	Pyramidal, 0.25 cm., red		Pressure	Normal periden. lamella; mod. loss bone; separation (filling in), upper right cen. incisors	Moderate anemic condition; 7,900 leukocytes (65% poly., 30% lymp.)	Albumin, trace, few renal cells	Conservative, tumor, and cautery	
16	1 cm. in diam., pedunculated, reddish hanging down over buccal side of upper left mol.	Little	Very often	No x-ray exam.				

*Red blood count and cells normal in all cases.

DATA ON SIXTEEN CASES—CONTINUED

Case	Age	Pregnancies	First Appearance	Recurrence	Duration of Present Tumor	Time of Pregnancy at Operation	Trauma	Previous Treatment	Location
1	18 (4/25/24)	One	3 mo. previously (3rd month)		3 months	6 months		Incised 3 times	Between upper left cusp. and 1st bicusp. (buccal-lingual)
2	21 (6/12/30)	One	4 mo. previously (5th month)		4 months	9 months		Removal at 2½ weeks	Between upper right lat. inc. and cusp. (palatal)
3	23 (7/ 7/25)	Unknown	4 mo. previously (4th month)		4 months	8 months			Upper right 3d mol. (palatal)
4	23 (11/12/29)	One	1 mo. previously (6½ months)		1 month	7½ months			Between upper left incisors (greater portion labial)
5	25 (8/18/25)	One	3 mo. previously (2½ months)		3 months	5½ months		Caustic	Between lower left lat. inc. and cusp.
6	26 (2/20/28)	One	11 mo. previously (5th month)		11 months			Some prophylactic treatment	Upper right bicuspids (palatal)
7	27 (6/22/21)	Two	1½ mo. previously (2d. preg., 7½ months)		1½ months	9 months			Upper cen. inc. (palatal)
8	32 (6/14/30)	Three	3 wks. previously (3d. preg., 7½ months)		3 weeks	8 months		Silver nitrate	Lower lip mucous surface

DATA ON SIXTEEN CASES—CONTINUED

Case	Age	Pregnancies	First Appearance	Recurrence	Duration of Present Tumor	Time of Pregnancy at Operation	Trauma	Previous Treatment	Location
9	35 (5/24/28)	Three	6 yr. previously (3d. preg.)		6 years				Between upper right lat. inc. and cusp. (palatal)
10	36 (2/ 6/24)	Three	12½ yr. previously (1st. preg.)	8 yr. previously (2d. preg.)	1½ yr. (3rd. preg., 2d. mo.)			I—Cut 2 times; spont. disappearance after birth II—Not cut; spont. dis. 2 mos. after birth	Between upper left incisors
11	27 (10/ 1/26)	Two	1½ yr. previously (2d. preg., 3d. month)	5 mo. previously (not pregnant)	1-2 weeks		Lower left 3d. mol. absent, extr'ct'd	I—Was cut II—Was cut	In region of upper left 3d mol.
12	29 (9/22/23)	Three	5 wk. previously (3d preg., 5th. months)		5 weeks	6½ months	5 wk. previously 8 teeth extracted, small growth noticed; now larger		Upper incisors and left cusp. (median line)
13	39 (7/15/24)	Two	5 yr. previously (1st. preg.)	3½ yr. previously (2d. preg.)	3½ years			I—spontaneous disapp. after-birth II—Cut many times	Between upper cen. inc. and anterior
14	20 (3/11/19)	Two	1 yr. previously (before preg.)	6 mo. previously (2d. preg.)	1 year			I—Spont. decreased but not completely	Right maxilla and mandible
15	36 (7/ 2/30)	Two	3½ mo. previously (2d. preg., 3½ months)		3½ months	7 months	Gold crown on upper right lat. inc. 20 years	Removal of crown 1 month ago	Between upper right incisors, greater portion labial
16	29 (7/ 3/30)	Three	1½ mo. previously (3d. preg., 6½ months)		1½ months	Not operated on	Gold crown on upper left 1st mol. bearing clasp for maxillar plate		Upper left 1st. mol. (buccal)

pause are examples. In the newest study of Citron,[2] in 50 per cent of pyorrhea cases, thyroid dysfunction was found. Certainly, pregnancy changes the whole endocrine system and, consequently, the vegetative nervous system, calcium metabolism, etc.

Thyroid dysfunction often causes in the skin of pregnant women some myxedema-like changes, and in most of our pregnancy tumors (we call them angiomas or angiogranulomas), a very distinct and marked myxomatous degeneration was observed. Such a section is shown in Figure 18. In one of the cases, the whole specimen shows a marked mucoid degeneration. We have no doubt that here some endocrine disturbance of the body had to exist. Arkövy's[3] opinion is that the main factor is the vasomotor disturbance and the anomaly of the wall and of the endothelial layer of the blood vessels, which seems to be the most plausible explanation and one adaptable to our cases.

In accordance with our study, we can state that these tumors apparently originate from the blood vessels; the inflammation is only a secondary factor. They arise from the blood vessels of the deepest portion of the connective tissue or from the periosteum itself, and usually show a marked myxomatous degeneration as a sign of certain endocrine disturbance of the body. Indeed, in our opinion, the disturbance in the endocrine balance must be seriously considered as a possible etiologic factor. Our study is not yet com-

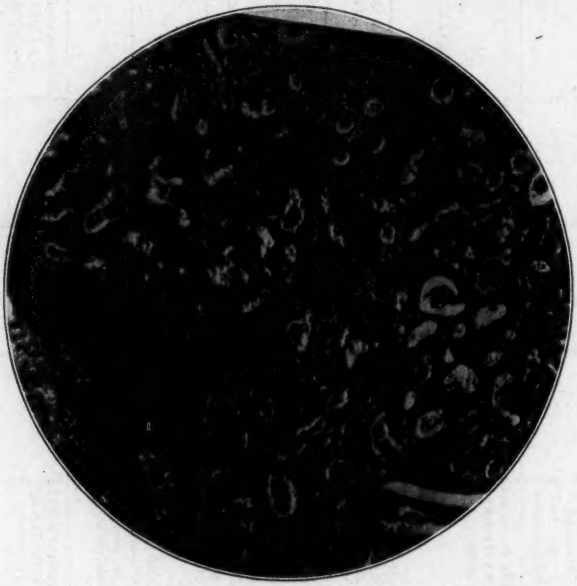

Fig. 14.—Gingivitis hypertrophica; vascular portion.

2. Citron, J.: Zur Frage der internistischen Aetiologie der Paradentose, Zahnärtzl. Rasch., 37, No. 32, 1928.

3. Arkövy: Die Gingivitis der Schwangeren und Menstruirenden.

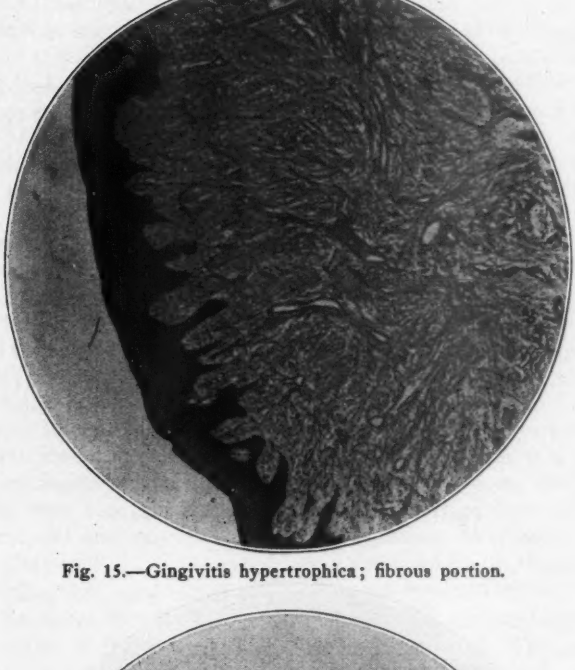

Fig. 15.—Gingivitis hypertrophica; fibrous portion.

Fig. 16.—Giant-cell epulis.

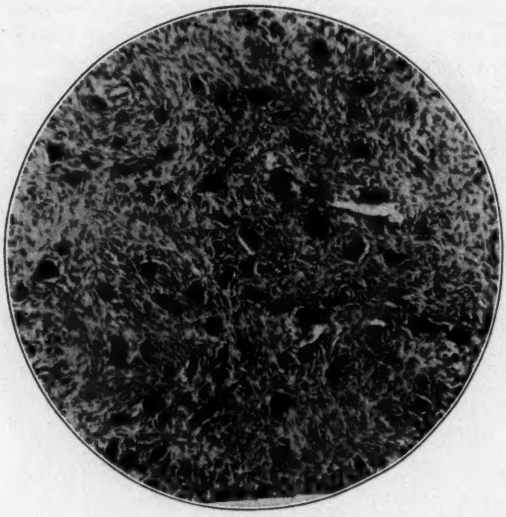

Fig. 17.—Giant-cell epulis (higher power).

Fig. 18.—Area of myxomatous degeneration in pregnancy tumor.

plete. We shall continue and cooperate with a specialist in endocrine diseases for this purpose.

Of the fourteen patients, two were operated on in the fifth month, one was operated on in the sixth month, and one in the seventh month. Two underwent operation in the eighth and ninth months. In one case, the time of pregnancy was unknown, and five were operated on when they were not pregnant. While some believe that no operation should be performed during the third and last month, I feel that these conditions as well as any ordinary care of the teeth are better attended to during pregnancy because the lactation period is very much more easily disturbed. Eight cases had previous treatment; five were incised several times; on two, caustics were used (in one case, silver nitrate), and one apparently had prophylactic treatment.

The operation here consisted of the removal of the tumor only in one case; tumor and cautery in four cases; tumor and periosteum in one case; tumor, periosteum and bone in one; tumor, teeth and bone in seven. In other words, 50 per cent of the cases were treated conservatively and the other half radically. At any rate, in none of the fourteen cases was there a recurrence, which, in my opinion, was due to the fact that no matter how small the mass was, it was removed by an incision carried out through the sound tissue and then enucleated *en masse*. The cautery was used mainly for its hemostatic properties. For protection, an attempt is usually made to cover the wound with iodoform gauze. In more extensive cases, this, of course, is a necessity. The dressing is changed every other day and the patient discharged in due time but kept under observation until the pregnancy is terminated.

As mentioned before, no recurrence occurred in any of the foregoing cases. The prognosis, therefore, is very good. It seems to me that prophylactic treatment instituted during pregnancy a little more often than otherwise, as well as the proper care of the patient by the obstetrician, may in some way influence or prevent the appearance of these tumors.

Cases 15 and 16 were not included in the general study. In Case 15, the patient wore a gold crown on a maxillary lateral incisor adjoining the tumor for twenty years. The crown was removed only one month before she was seen. The tissue removed showed chronic inflammation, fibrous tissue and some new bone formation. In other words, it is not a pregnancy tumor. Trauma due to the gold crown must have been an important etiologic factor. Whether or not it may have developed in due time into a giant-cell tumor is difficult to say.

In Case 16, unfortunately, operation was not performed. This case, because of the presence of a gold crown on a maxillary molar, was similar to Case 15, although I feel, from its clinical examination, that it may have proved to be a giant-cell tumor microscopically. If her physician had cooperated, the patient would have probably submitted to the operation. He felt that he wished to wait a week to see whether it would not disappear.

CONCLUSION

The blood picture in the case of the pregnancy tumor (angiogranuloma) is physiologically normal (leukocytosis with increased polymorphonuclear leukocytes), which differentiates it from the giant-cell epulis in which a lymphocytosis of from 30 to 35 per cent has been observed. As the urine in pregnancy often shows a trace of albumin, the fact that such a

trace is found in giant-cell epulis cases must be judged with caution. The differential diagnosis is extremely important on account of the fact that the operation for the removal of a giant-cell tumor is necessarily radical, requiring also the removal of teeth and bone, because it originates from the pericemental membrane or spongiosa.

Pregnancy tumors are apparently blood vessel tumors originating from the deeper structures of the gingiva and possibly from the periosteum. A disturbance of the endocrine balance must be seriously thought of as an etiologic factor. The roentgen-ray diagnosis is very important on account of negative findings.

With all this in mind, pregnancy tumors should be removed surgically. Although they disappear at times after pregnancy, they also reappear afterwards or during another one. The separation of the adjoining teeth must also be taken into consideration. The operation itself, being conservative and consisting of the removal of the tumor itself (and the periosteum for greater safety), is so simple that no logical objection can be raised against such procedure as soon as such a tumor is noticed. The additional use of the cautery is advisable.

As soon as the true nature and relationship, if any, of the pregnancy tumor to the endocrine system is fully established, treatment of this system may replace surgical treatment. Meanwhile, we must adhere to surgery in view of the fact that the prognosis is excellent, our studies revealing no recurrences.

101 East Seventy-Ninth Street.

DISCUSSION

William L. Shearer, Omaha, Nebr.: The application of actual cauteries to tumor growths in the mouth more often brings about a filthy condition and accomplishes nothing that good surgery will not do. In the removal of any of these pregnancy tumors, one should reflect the mucoperiosteum lingually and buccally, and if the tumor is attached to the pericemental membrane of the adjoining teeth, such teeth should be removed. Packing in these cases is not necessary, for if they are handled in the manner that I have outlined, primary union will take place. One, of course, must remove all of the inflammatory tissue along with such infected bone as may be presented. Therefore, we do not need to use packs nor do we need to use cauteries.

Dr. Blum (closing): Mouths are dirty and they have to be cleaned before operation. In the typical pregnancy tumor, there is no tissue for a flap as the tumors are very small. I cannot see anything particularly objectionable to the use of either a dressing or a cautery. It is true that most of the wounds in other surgery in the mouth are closed nowadays, and I am very much in favor of that; but as long as this wound cannot be closed, we feel that the patient is a little better protected if we cover the wound with gauze. That is a matter of personal preference, and I would not try to force anybody to use a dressing if he did not wish to. In my opinion, the use of a cautery is of great advantage because, during pregnancy, as you have noticed, the bleeding in this area and those adjoining is at times profuse. It would be entirely wrong to use a cautery and leave it immediately on the bone for many seconds, because the bone would be destroyed; but if we go over the exposed bone with the cautery we will find that it will help a great deal.

SIGNIFICANCE OF PASSIVE BACTEREMIAS*

By U. GARFIELD RICKERT, A.M., D.D.S., Ann Arbor, Mich.

THERE has been some justifiable criticism of certain papers that have been presented before this group, on the ground that they would have been more appropriately given before operative sections. On the other hand, there has been criticism of certain papers presented here and published in our official journal on the ground that they were too technical to be properly evaluated by the profession that the research report attempted to serve. This paper has been prepared with a full consciousness of the precept that, for scientific reports, there is a conventional procedure limiting it to cold facts, observations stripped of interpretations. There are many reasons that such reports should be given to the strictly scientific sections, composed entirely of scientific workers qualified to digest and critically discuss the experimental observations, and published only in appropriate journals.

I have at this time departed somewhat from the orthodox method of presentation for two reasons: 1. The character of the experimental subject matter is such that we believe it of immediate concern to the more accurate dental diagnoses that have to be continuously made in general practice. 2. This paper is to be published in THE JOURNAL, which is devoted to the educational advancement of the entire profession, and unless sufficient of the practical applications are included to be of interest to the majority of its readers, and of the listeners here, our efforts become both extravagant and futile.

There is no necessity for denying the fact that many of us have written papers that have been directed more to a few of our contemporary workers than to the edification of the profession at large. This was unavoidable in our earlier experience. Fortunately, the phenomenal increase in the volume of painstaking and carefully executed dental research has developed new agencies more appropriately adapted for both the presentation and the publication of the strictly scientific papers. I have reference to the increasingly interesting programs of the International Association of Dental Research and the subsequent publication of these papers in the official organ of that association. This introduction is submitted as an explanation, not an apology.

There have been no professional groups of men more determined to find and willing to abide by the truth than dentists. In the few years of my contact with the profession, I have been repeatedly impressed with the interest that practicing dentists have given research. They have been willing to listen to long tedious laboratory reports. They have accepted and have given practical application to research results as rapidly as there was

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 23, 1930.

general agreement on fundamental findings. The confusion that exists today relative to certain aspects of dental practices can usually be attributed to the conflicting research data that have been submitted to the profession. It is for this reason that I believe a discussion of the significance of bacteremias highly important at this time.

BACTERIA IN THE BLOOD STREAM

Twenty years ago, the discovery of micro-organisms in the tissues, and especially in the blood, would have been viewed with alarm. Even a number of years later, the idea still prevailed that the blood from apparently normal individuals was always free from bacterial organisms. It was with few exceptions (only in cases of ulcerative endocarditis and the most morbid septicemia) that blood cultures had been proved positive. More recent investigations have indicated passive bacteremias of rather common occurrence, which may or may not be of serious pathologic significance.

BACTERIA IN THE TISSUES

The frequency with which bacteria have recently been found in various tissues by some bacteriologists has become quite disturbing to many thinking practitioners of both medicine and dentistry. In our profession, one hears of infected sclerotic bone, an ill-defined term to say the least. Others even find the cancellous bone in edentulous cases infected. Dr. Lucas[1] believes the vital pulps of many impacted third molars to be infected, and now we and others have been observing the frequency with which many degenerating vital pulps become infected. In fact, all this has added confusion to an already acknowledged complication of conditions. Many dental practitioners have asked me why, in the absence of exacerbation, they should become disturbed by the presence of organisms in the periodontal tissues, since such organisms have been so frequently demonstrated in other tissues of apparently normal individuals. The complexity of the situation is well illustrated in a letter that I recently received from one of New York City's outstanding students of dental problems. He said, "This streptococcus business is getting me addlepated. Will you please tell me whether you think the streptococcus (being found in the normal bone, in the saliva and in fact almost everywhere) is really a result or a cause?" In other words, he asks: "If necrotic tissue is present, can we be sure that the streptococcus is not present in multiplied numbers simply as a saprophyte?"

A few days ago, I received another letter from a prominent surgeon, who raised this question. He said that a certain authority made the statement that "the mere presence of bacteria does not constitute infection." He said, further, that, to him, "the presence of bacteria in the tissues must constitute infection," adding: "If not, just how do you distinguish between infection and the presence of organisms in the tissues?"

These inquiries lead us to the following questions: Are the tissues of normal individuals, in the absence of focalized infection, harboring bacteria as the work of some bacteriologists would indicate? and, finally, of what significance are organisms when found in these tissues, and especially in the blood streams of apparently normal individuals? It requires an imagination almost as flexible as is required to fathom the extent of space, to comprehend the numbers of organisms, principally streptococci and staphylococci, present on the various coverings and pro-

1. Lucas, C. D.: Periapical Infection, Dent. Cosmos, 71:555-564 (June) 1929.

tective linings, such as the skin and mucous membrane.

When one stops to consider how this comparatively thin barrier prevents the ingress of these hordes into the deeper structures, it comes to be regarded as one of the most amazingly efficient mechanisms to be found in all nature. In fact, the wonder of it all is that organisms are not more frequently found in every tissue. It becomes evident. then, that we can only, with the most painstaking technic, culture the deeper tissues, because such cultures must, as a rule, be taken through regions supporting myriads of the very organisms described as found in normal tissues. This is especially true in culturing the tissues approximating the oral cavity. We believe, to state it briefly, that it is dangerous to accept too seriously the data indicating the common presence of organisms in the structures of normal tissue.

At the University of Michigan, Dr. Lyons and I have carefully cultured the maxillary bone contents between the cortical plates in many cases, taking great pains not to get contamination at the point of entrance, and we cannot understand the seeming frequency with which others have obtained positive cultures in these normal tissues.

We have curetted the apical ends of many pulpless teeth by the window method, and under these conditions a certain percentage of them, unfortunately too large a proportion, were found to be infected. We did not find one positive culture in apparently normal maxillary bone. While we have procured cultures from the lesions of laboratory animals previously injected with tremendous doses of streptococci, it is our firm conviction that it is seldom possible to find organisms in normal tissues, and that when such organisms are found within the tissues in the absence of lesions, they are still confined within the walls of the smaller blood vessels and their presence is not indicative of a true infection.

What, then, is a true infection if the presence of organisms within the tissues does not constitute an infection? A distinction that we would like to make here is that unless the presence of organisms induces an inflammatory reaction on the part of the tissues involved, the condition is not considered an infection. For example, the mucous linings are always teeming with organisms, and yet it is only considered that an infection exists when there is evidence of a reaction on the part of these tissues.

A still finer discrimination of dental application is the question as to whether the granulomas at the apices of pulpless teeth, even those sustaining a few organisms, are infections. Every tissue reaction, whether chronic or acute, painful or nonpainful, we should consider as an infection, provided the histologic examination proves inflammatory tissue reaction to the organisms. In this instance, one must not overlook the fact that the inflammatory tissue reactions of the granulomas are not always due to the presence of bacteria. Some are due to the presence of toxins caused by stasis of the circulatory elements, and others are due to chemical irritation from unsuitable root-canal filling material, etc.

The question as to "whether the presence of organisms in the blood stream really constitutes infection in every case" is still a debatable one, since the circulating blood must be considered as one of the body tissues, and since the organisms in the blood stream cannot be demonstrated to be regularly present. To state the matter briefly: The blood stream like the normal tissues, with the few exceptions previously cited, is found free

from bacteria. This must not be interpreted to mean that micro-organisms do not frequently enter the circulation. The evidence is that they do, but these foreign invaders are so highly diluted and rapidly eliminated from the blood stream that they are difficult to recover in blood cultures.

More than forty years ago, Wyssokowitsch[2] demonstrated the rapidity with which astoundingly large numbers of various organisms disappear from the blood stream. Millions of *Bacillus subtilis,* following intravenous injection in his laboratory animals, completely disappeared in a few hours. The question arose: "How were these organisms so rapidly removed?" A number of years ago, I was interested in a study of the circulation of the several tissues of the tooth, with special reference to enamel. Dyes were injected into the ear veins of laboratory animals. The blood content was darkened to the extent that, even in a few seconds, the skin and mucous membranes became markedly bluish black. This dark color again disappeared with astonishing rapidity.

Because of these personal observations, we later became interested in the experiments of Hobo,[3] who injected finely divided India ink. The skin and mucous membrane of his injected animals also turned dark, and necropsies an hour or more later, after the subcutaneous tissues had again returned to normal color, proved that the dye particles had been removed in tissues of retarded circulation: the spleen, liver, and bone marrow. Other substances, such as lamp black, have likewise been used, with similar results. In our own laboratory, we are at the present time injecting concentrated suspensions of various strains of deeply stained cocci. This work is still incomplete. We are trying to demonstrate both their fate and the rate of disappearance from the retaining tissues. In these regions of retarded circulation, the invading organisms come in close contact with the reticulo-endothelial system and are rapidly removed by phagocytosis.

There is considerable evidence that when the retarded circulation is due to a circulatory derangement within the traumatized tissues, the fate of the organisms may be different; for without the capacity for rapid elimination, as is found in the bone marrow and spleen, we now have a field favorable for the establishment of a new focus of infection. This concept is of especial interest to the dentist because it clearly demonstrates the most plausible source of infection of both the traumatized vital pulps and the drugged or instrumentally traumatized periapical tissues. Our clinical and experimental studies during the past few years have indicated this as the most common source of infection of these two tissues.

Localized infections may be established as a result of bacterial embolism. There is an abundance of evidence that many secondary foci of infection are initiated in this way. When these in aggregate pass into the peripheral circulation of traumatized and deranged tissues, embolisms are frequently formed producing infected localized lesions. Whether such embolisms will be passive or permanent will depend on the degree of abnormality of the invaded tissue; the virulence, source and numbers of the organisms, or the degree of resistance due

2. Wyssokowitsch, W.: Ueber die geschicksale der in's blut injurten mikoorganismen im korper der warmbluter, Ztschr. f. hyg., 1:3, 1886.

3. Hobo, T.: Pathogures[is] of Osteomyelitis, Acta Scholae Med., 4:1.

to the inherent defensive mechanism of the patient.

Our interest in this aspect of the subject was first aroused by the frequency with which intestinal flora were found in the cultures taken, before extraction, from the dead pulps of teeth in which the pulp chambers had not previously been opened. Under these conditions, there was less likelihood of the original pulp infection resulting from invasion through the dentin, since the uninvolved dentin, through which the culture was taken, was cultured for control purposes and found sterile. Finally, what is even more convincing is the fact that circulatory metastases offer a more plausible source. Henry S. Dunning[4] quotes Anthony Bassler of New York as saying, "Most pulpless teeth become pulpless by the predilection that the intestinal organisms have for pulps that have lowered resistance. They are carried through the blood." There is certainly much evidence supporting Dr. Bassler's theory. During the past year, M. D. Mackoy, working in my laboratory, made a study of a large number of pulps under fillings of various size as compared with those of approximately equal age and history with no fillings. The large numbers of degenerated pulps found under coronal restorations will become appalling, if the attendant infections, as we find them and Dr. Bassler finds them, prove to be comparatively high. The cases that we have studied so far have come from patients suspected of harboring secondary infections. How large a percentage of all degenerated pulps are infected, regardless of the state of health of the patient, we do not know. I am extremely glad that there are other students of the subject who have independently made this discovery. We have isolated at least four of the many strains of the intestinal flora that Dr. Bassler mentioned. We studied cases to find out whether there was a relation between intestinal flora involvement of the teeth of patients with chronic intestinal stasis. So far, no definite correlation has been proved.

Dentistry has even more convincing evidence of the possibilities of these periodic bacteremias in the frequency with which slightly traumatized vital pulps become infected with rather specific strains. Some of the most striking illustrations of apparent elective localization that we have thus far observed have been produced in laboratory animals with cultures taken from slowly degenerating, though still vital, pulps. This is especially easy to demonstrate with strains taken from peptic and duodental ulcer cases. A number of cases will be cited to illustrate this point of view.

REPORT OF CASES

Case 1.—About two years ago, a patient showing indications of duodenal ulcer came in for a dental diagnosis. A well-treated pulpless tooth was cultured on suspicion, with negative results. Because of this, the patient refused to have the tooth extracted. About a month later, he returned and said that he felt an occasional twinge in the pulp of an upper molar which had a large amalgam filling responding normally to all vitality tests. He was prevailed on to have the tooth extracted. On subsequent examination, it was observed that the horn of this pulp adjacent to the large filling had receded from the dentin for more than 1 mm. and was stained a dark gray, the color being quite like that of the dentin under the filling. The culture proved a streptococcic infection. The first rabbit inoculated with the culture developed multiple pyemic abscesses of the intestinal mucosa. The patient was operated on soon after this and is now entirely well.

We do not attribute the recovery to the extraction of the tooth, for we believe that we just happened to locate a secon-

4. Dunning, H. S.: Dent. Survey, 6:58 (July) 1930.

dary focus of infection in this degenerating pulp that had become infected from the blood supply at a time of an overflow from the primary focus. It is quite probable that if this secondary pulp infection had not been eliminated, the ulcer operation might have been less successful. While cases of this type may not conclusively prove the incidence of passive bacteremias, it is at least convincing evidence. In acute cases of arthritis and eye involvement, the most phenomenal recoveries have followed the extraction of proved infected degenerating vital pulps. In many of these cases, allergy plays an important part.

Many of you may recall from personal experience an occasional slight, but not unpleasant, twinging vital pulp sensation. These occur most frequently during exacerbations, streptococcic in character, of coryzas, tonsillitis, etc. While it would be impossible for me to prove my theory, I have come to suspect that these sensations are due to two causes, transitory embolism, resulting in permanent localized infections within the traumatized areas of these still vital pulps, or partial strangulation of the pulps following atrophic changes. In fact, these sensations have at times been the only available clinical evidences of probable pulp degeneration, from which a differential diagnosis could be made.

CASE 2.—Six years ago, a dentist from a small Michigan city telephoned that his sister, who was suffering from partial paralysis of the right arm and was also losing her vision, was in his office for the extraction of all of her teeth. He said that the two best internists in the city of Detroit advised this drastic procedure. He asked me whether I believed that he should follow their advice. My answer was "Yes." He said, "They are all vital teeth. Do you still think that I should do it?" I again said, "Yes, because your sister's condition will probably not improve whether the teeth are extracted or not, but should you refuse to do it, and should she take your advice, there is always the danger that she may become totally blind and she will have plenty of time for reflection on the fact that if she had not listened to her brother's advice, and had resorted to complete extraction, she might have had her sight completely restored." So, in self-defense, I recommended the extraction of all teeth in compliance with the physician's request. After extraction, the dentist prepared the teeth as I directed, and mailed them to me, so that they were in our laboratory for culturing twelve hours later. Only six teeth were cultured, because it is rather a tedious procedure to remove vital pulps and culture just the bulbous portions and be reasonably sure that they are not contaminated. Of the six teeth all had normal pulps but one. This was a lower bicuspid that had no cavity or filling. For some unknown reason, the pulp had receded from the normal position in the pulp chamber and gave gross evidence of some form of pulp disease. From this pulp culture, we obtained a strain of hemolytic staphylococcus, a form seldom found in pulp-involved teeth. The first rabbit inoculated with this culture developed, within fifteen hours, marked discharges and engorgement of the eyes, and, within twenty hours, complete paralysis of the anterior extremities. In about thirty hours, the animal died from septicemia. Animals inoculated with cultures taken from the blood of this rabbit even in smaller doses, all died from septicemia in less than twenty hours.

I mention this case because it is quite apparent that the primary focus of infection in the patient was probably located in the upper part of the spinal tract and that we either happened to have extracted the teeth immediately after an overflow from this source or else the evident pulp disease might have originally been caused by embolisms from the same source. As predicted, the patient's condition did not improve. While the first evidence on the laboratory animals showed a rather marked specificity, it would be difficult to prove that the tooth was the primary focus of infection. The evidence is overwhelming that, in this case, it was secondary. It is easier to

explain it as the result of periodic or passive bacteremia. Blood cultures taken in large quantity and at just the right moment and place would probably have proved positive.

There is another condition in which passive bacteremia is probably induced which is of interest to the dentist. It may arise from two sources after extraction. The pumping motion during extraction may force the organisms from the highly infected gingival area into both the venous and the arterial circulation; and this same motion may also drive the organisms, if infected, from the local periapical involved area into the general circulation. The high percentage of vital pulps that have been reported as infected by some observers may be due in part to infection driven into the circulation during the time of extraction. We have regularly observed it to be true when a number of teeth are extracted from the same quadrant at one sitting that if one starts in the anterior region and extracts teeth posteriorly, the last of the teeth extracted progressively yield a higher percentage of positive cultures in the vital pulps.

CASE 3.—Four days ago, we started extracting teeth from a young arthritic patient. The three anterior teeth first extracted were recently treated pulpless teeth. The cultures from these proved negative. The first, second and third molars, all vital, developed positive streptococcic cultures.

A histologic study of these degenerating pulps will be made soon; but from gross examination, the following conditions were observed. The first molar, with a large gold inlay, gave evidence of calcific vital pulp degeneration; the second molar, with a much smaller filling, gave slight evidence of atrophic changes; the third molar, with a very small fissure filling, gave no evidence of pulp degeneration; yet all three pulps immediately after extraction, yielded positive cultures. For some reason not clear to us, the one pulp contained only R types, another the S types, and the third a mixture of the S and R types. The R types in 3 c.c. doses killed rabbits in a few hours.

When the patient returns for removal of the second quadrant on the opposite side, we will culture the pulp chamber contents through openings of uninvolved enamel and dentin. In these cases, we will leave the vital pulp of the canal intact to be cultured after extraction. This will give us some evidence as to the possibility of forcing the organisms into circulation during the time of extraction. The systemic exacerbation frequently following the extraction of a large number of teeth is clinical evidence of such metastases. Some of these effects are not necessarily attributable to the metastasis of the organisms themselves, but are rather due to the increased liberation of toxins and split proteins. We are endeavoring to find out whether there is a difference in the extent of the invasions of the pulps when a number of teeth are extracted at one sitting, if one begins in the anterior part of the mouth and progresses backward or begins posteriorly and advances forward. Briefly stated, are these organisms more readily taken out by the venous or by the arterial circulation, since in both cases the blood supply of the teeth in the quadrant emanates from one vein or artery?

Our experimental work so far indicates that the most exacting cultures must be made from pulps through sound tooth tissue previous to extraction. Too much stress may not be placed on the significance of the large percentage of vital pulp infections, especially when many teeth that are cultured have been extracted at one sitting.

In view of the fact that Harter[5] found

5. Harter, J. H.: Significance of Bacteremia Found Following Mastoid Operation, Northwest Med., 24:35-37 (Jan.) 1925.

fresh wounds teeming with bacteria, the ideal condition for the experimental production of bacteremias, we were very much interested in the blood cultures made after tonsillectomies by Rubin, Epstein and Werner.[6] To summarize their work: Blood was taken from seventy-eight selected patients after tonsillectomy, all patients showing evidence of recent throat infection. About half of them had a postoperative rise in temperature, some to 103 F., yet not one of these blood cultures proved positive. In view of the fact that the organisms are so readily eliminated from the blood stream as previously described, it is very evident that large quantities of blood taken at just the right moment must be used for these cultures.

The peculiar peripheral circulation of the dental pulp makes it ideally suited for the retention of organisms, especially in cases of pulp degeneration. As stated before, we do not yet know how many of all involved pulps become infected, because our work so far has been carried on largely on patients suspected of some secondary infection. Sufficient work has been done to prove beyond doubt, in our opinion at least, that the most outstanding problem before the dental profession today, other than preventive dentistry, if it is to successfully manage dental infections, is the greater protection of pulps under all kinds of dental restorations.

6. Rubin, M. I.: Epstein, I. M., and Werner, M.: Blood Cultures Following Tonsillectomy, Amer. J. Dis. Child., 38:726-729 (Oct.) 1929.

SUMMARY

We have been unable to demonstrate the presence of organisms in normal tissues with the possible exception of those due to temporary detention in the capillaries of a few normal pulps, the last to be extracted from the same quadrant.

2. There is convincing evidence that organisms do appear in the circulation periodically from certain lesions and perhaps rather commonly from the digestive tract, but because of the high dilution and the rapidity with which the organisms are removed, as described, from the circulation, it is difficult to locate them by means of blood cultures.

3. A true infection is, in the broadest sense, not determined by the presence of organisms, but by the supporting tissue reactions.

Finally, our observations have been convincing that the most fruitful field for the improvement of its health service, other than preventive dentistry, that the dental profession has is the greater protection of vital pulps under all forms of dental restorations.

HEALING TIME OF FRACTURES OF THE JAW IN RELATION TO DELAY BEFORE REDUCTION, INFECTION, SYPHILIS AND BLOOD CALCIUM AND PHOSPHORUS CONTENT*

By DONALD EDWIN WOODARD, M.S.D., Kansas City, Mo.

REVIEW OF THE LITERATURE

DUNNING,[1] Ivy and Curtiss,[2] Berger and others have tabulated the gross findings and recorded the case histories in a large number of jaw fractures and have supplied an adequate classification. The following factors have not been completely studied and reported on:

1. The effect of delay in reduction on the healing of the fracture. Reiter states that "a delay in the treatment of fractures of the mandible is apt to prolong the healing process. Injury to the periosteum and a diminished blood supply will retard the healing process.[3]

2. The effect of infection on the healing of a fracture. "Severe lacerations of the soft tissues complicated by secondary infection will retard the healing process.[3] "In the presence of infection, bony union in jaw fractures occurs in from four to six weeks." (Speed.[4])

3. Leukocytosis in jaw fractures. Walton[5] made leukocyte counts in 260 selected cases, in which compound fractures of more than twenty-four hours' duration were not included, thus ruling out infection. He summarized his work as follows:

> Traumatic injury to bone gives rise to a moderate leucocytosis, chiefly polymorphonuclear in type. This elevation in the white count reaches its maximum within twenty-four hours following injury, and it remains at approximately this level until the fracture is immobilized. The proper reduction of the fracture and the immobilization of the fragments is followed by a rapid fall in the white count, which reaches normal by the fifth or sixth day. Old debilitated patients usually develop less leucocytic reaction in the case of a fracture than do children or young adults.

The increase in the white count appears to be due to injury to the bone and the periosteum, but varies in proportion to the amount of soft tissue injury and displacement. The average number of leukocytes in four jaw fractures included in the report was 10,700.

Many reports were examined, all of

*From the oral surgery service of the Cook County Hospital, Chicago, Ill.

*Read before the Section on Oral Surgery and Radiography at the Midwinter Clinic of the Chicago Dental Society, Jan. 15, 1930.

*Submitted in partial fulfilment of the requirements of Northwestern University for the degree of master of science in dentistry.

1. Dunning, H. S.: Dent. Cosmos, 57:1915.

2. Ivy, R. H., and Curtiss, Lawrence: Jaw Fractures, Dent. Cosmos, 68:439 (May) 1926.

3. Reiter, Edward: Study of Jaw Fractures, unpublished data.

4. Speed, Kellogg: Fractures and Dislocations, Philadelphia: Lea & Febiger, 1916, pp. 214-242.

5. Walton, R. W.: Leukocytosis Accompanying Fractures, J.A.M.A. 88:1138-1140 (April 9) 1927.

them covering the etiologic factors, methods of fixation and estimated time of healing. When the patient comes in, the etiology is already a definite factor and the fixation a mere mechanical problem. Infection is a vital factor in jaw fracture cases. One should know when to expect it, and, when it does set in, what effect it will have on the healing of the fracture. Case histories of jaw fractures are usually not complete and are of no value in a study of this kind unless they follow the case from presentation to union.

4. Blood calcium and phosphorus content. Many theories have been advanced as to the value of the amount of calcium and phosphorus in the blood in the healing of fractures. The medical literature offers a wealth of reports on calcium and phosphorus metabolism experiments. These experiments, though not on jaw fractures, answer many of the questions. I here present the questions and findings in the literature.

TABLE 1.—NORMAL CASES

Age Years	Calcium Content (100 c.c.)	Phosphorus Content (100 c.c.)	Product
36	10.1	3.79	40.30
26	10.4	3.09	32.13
17	10.2	4.20	42.84
40	10.9	3.85	41.06
62	10.5	3.69	38.75
50	10.6	4.37	46.32
43	10.6	5.66	59.99
30	10.6	3.89	41.03
44	10.7	4.30	46.01
15	10.4	4.55	47.31

A. What effect does the blood calcium level have on the healing of fractures?

Peterson,[6] in a study based on eighteen cases of nonunion, placed emphasis on the part played by calcium and phosphorus in bony union after fractures. He found that, in many cases of nonunion, there is an underlying basis, which is made manifest as a deficiency in the concentration of the inorganic bone-forming elements of the blood. This existed as either a subnormal calcium or phosphorus content of the blood serum. In nine normal cases and nine cases of nonunion, he found that union was not likely to occur if the product was less than 30. Little healing would occur if it was between 30 and 35, and active healing would be more frequent if it was between 35 and 40. The deduction was that, in cases of nonunion, there is a constitutional disturbance causing a reduction of the concentration of the calcium and phosphorus below normal and that the normal concentration can be restored by diet and drugs.

TABLE 2.—FIVE CASES OF NONUNION

Age	Calcium Content	Phosphorus Content	Product	Time Since Fracture
36	11.5	2.93	30.47	3 months
39	10.4	3.95	40.68	4 months
12	10.2	4.51	46.00	8 weeks
38	10.9	3.85	41.97	9 weeks
33	10.1	3.59	36.26	6 weeks

B. Can the calcium and phosphorus content be raised? How? Can it be considered as a valuable aid in the treatment of fractures?

Telfer, Orr, Holt, Wilkins and Boone have shown that the condition which above all favors the solution of the calcium phosphate in the gastro-intestinal tract is acidity. The problem is the fixation of the absorbed calcium and phosphorus in the bony skeleton.

Bauer and Ropes,[7] in a study of seventeen normal persons, found that: 1. Calcium lactate administered in 5 gm. doses to nine normal persons gave a maximum elevation of 14 per cent of serum calcium.

6. Peterson, H. A.: Bull. Johns Hopkins Hosp., 35:378-381 (Nov.) 1924.

7. Bauer, W., and Ropes, M. W.: Effect of Calcium Lactate Injection on Serum Calcium, J.A.M.A., 87:1902-1904 (Dec. 4) 1926.

TABLE 3.—BONE FRACTURED; CAUSE, KIND AND DEGREE OF FRACTURE*

Case	Bone	Cause	Kind	Degree
1	Mandible	F	D	C
2	Maxilla	A	T	C
3	Mandible	F	S	C
4	Mandible	F	D	C
5	Mandible	F	D	C
6	Mandible	Fall	S	C
7	Mandible	F	D	C
8	Mandible	F	D	C
9	Mandible	F	S	SS
10	Mandible	Fall	S	C
11	Mandible	A	D	C
12	Mandible	F	S	SS
13	Mandible	Fall	S	SS
14	Mandible	F	S	SS
15	Mandible	F	S	C
16	Mandible	A	S	C
17	Mandible	Unknown	S	SS
18	Mandible	F	S	C
19	Mandible	F	D	C
20	Mandible	Fall	D	C
21	Mandible	F	S	S
22	Mandible	A	D	C
23	Mandible	A	S	C
24	Mandible	F	D	C
25	Mandible	F	D	C
26	Mandible	F	S	C
27	Mandible	A	S	C
28	Mandible	F	S	C
29	Mandible	F	D	C
30	Mandible	F	S	C
31	Mandible	Fall	S	C
32	Mandible	F	S	SS
33	Mandible	F	D	C
34	Mandible	F	D	C
35	Maxilla	Fall	D	C
36	Mandible	A	S	C
37	Mandible	Fall	S	SS
38	Mandible	Ball Bat	S	C
39	Mandible	Ball Bat	S	C
40	Mandible	F	S	C
41	Mandible	F	S	C
42	Mandible	F	S	C
43	Mandible	A	D	C
44	Mandible	F	D	C
45	Mandible	F	S	C
46	Mandible	F	D	C
47	Mandible	Fall	D	C
48	Mandible	F	D	C
49	Mandible	A	S	C
50	Mandible	Fall	D	C

*F, fist; A, auto; S, single; D, double; T, triple; SS, simple; C, compound.

TABLE 4.—SEX OF PATIENTS AND LOCATION OF FRACTURES

Case	Sex	Location
1	M	R A L C
2	F	R Max. L Max.
3	M	R Mol.
4	M	R B L A
5	M	R C L A
6	M	R B
7	F	R A L C
8	M	R Mol. L Mol.
9	M	L Mol.
10	F	L Mol.
11	F	R B L A
12	M	Symphysis
13	M	Condyle
14	M	L A
15	M	L Ramus
16	M	L C
17	M	L B
18	M	R Mol.
19	M	R B L A
20	M	R Mol. L B
21	M	R Mol.
22	M	R A L A
23	M	R B
24	F	R A L B
25	M	R Mol. L B
26	M	L Mol.
27	M	Symphysis
28	M	R Mol.
29	M	R A L C
30	M	R Mol.
31	M	R Mol.
32	F	L B
33	F	L Alveolus
34	F	R B L A
35	M	Zygoma
36	M	R A
37	F	L A
38	M	L B
39	M	R A
40	M	R A
41	M	L A
42	M	R B
43	M	R B – R Mol.
44	M	R A L T
45	M	Symphysis
46	M	R A Symphysis
47	M	R Ramus Symphysis
48	M	R A L C
49	M	R A
50	M	R B L A

*A, angle; B, bicuspid; Max., maxilla; Mol., molar; C, cuspid.

This maximal rise comes between the first and fourth hour after injection, but some elevation is usually maintained over a period of twelve hours. 2. Calcium lactate given in 10 gm. doses to eight normal persons produced a similar but more pronounced increase, the maximal rise being 28 per cent and occurring between the first and the fifth hour. Again some elevation was maintained above the fasting level for twelve hours.

Salvesen, Hastings and McIntosh reported a rise of 20 per cent in serum calcium in a dog after the oral administration of 7.5 gm. of calcium chlorid daily. Jansen found calcium bicarbonate to be the most efficient in raising the calcium. Collip demonstrated that, by the use of a parathyroid extract prepared by him, the blood calcium content could be more than doubled by repeated injections at short intervals.

Many other investigators have reported the raising of the calcium content of the blood. Ravidin and Jonas[8] state: "The addition of calcium or phosphorous elements to the diet indiscriminately may not only produce no beneficial results, but it may even prove harmful in that a negative balance may occur. The ordinary diet contains sufficient mineral matter for body metabolism, but whether or not this can be used is a different matter. The problem is the fixation of the absorbed calcium and phosphorus in the bony skeleton." They do not believe that, with normal metabolism, the administration of these elements will be of any benefit. Their report covers ten cases of normal union and five cases of nonunion. The figures accepted as the normal range of the phosphorus content for adults were from 3.2 to 4.3 mg. per hundred cubic centimeters of serum. In children, it is somewhat higher. The normal calcium content of the serum accepted varied from 9 to 11 mg. per hundred cubic centimeters of serum. The age seemed to have something to do with the healing, especially after 35.

The calcium-phosphorus content in all the cases but one was above 35, and in this one case, healing was normal with two fractures.

The average product in Table 2 is no lower than in Table 1, when we consider the fact that the product is higher in children. They believe that, in the normal individual, the metabolism of these elements plays only an indirect rôle in delay or nonunion, and that other factors well understood play the major rôle. Their conclusions of interest were that (1) the mere addition of these substances (calcium and phosphorus) to the normal diet is probably useless; (2) in certain cases of delayed union or nonunion, deficient retention and fixation of the calcium and phosphorus may result in nonunion, but this cannot be recognized from the blood serum estimates.

The consensus of opinion is that the calcium can be raised, but it is questionable whether or not the increase is utilized or whether it is thrown off. The fact that the raise is not a stable one would lead us to accept the latter theory.

C. Which of the elements, calcium or phosphorus, is the more important in bone formation?

Tisdall and Harris,[9] in a report of forty-two normal cases, state that the phosphate content is higher in children than in adults. Their patients varied in age from 4 months to 44 years. Those

8. Ravidin, I. S., and Jonas, L.: Calcium and Phosphorus Metabolism in Fractures, Ann. Surg. 84:37-41 (July) 1926.

9. Tisdall, F. F., and Harris, R. I.: Calcium and Phosphorus Metabolism in Patients with Fractures, J.A.M.A., 79:884-937 (Sept. 9) 1922.

TABLE 5.—DATA ON FIFTY CASES*

Case	Delay Days	Union Days	Drainage (Infected Cases)†	Drained Days	Age Years
1	234	48	0		23
2	207	29	0		22
3	114	52	I	28	42
4	168	42	0		22
5	87	39	0		25
6	984	38	E	0	42
7	276	70	E	22	38
8	84	40	0		28
9	2 years	106	0		32
10	96	92	E	18	22
11	500	63	E	15	21
12	165	39	0		52
13	No reduction	27	0		53
14	93	31	0		49
15	189	53	E	30	48
16	144	62	I	18	35
17	No reduction	37	E	15	55
18	184	38	E	24	25
19	12	70	I	28	24
20	12	43	0		52
21	13	35	0		30
22	48	45	0		17
23	48	41	0		45
24	862	45	I	34	42
25	1560	41	E	0	24
26	156	110	E	6	25
27	162	30	0		30
28	62	34	E	28	22
29	256	30	0		30
30	113	35	0		31
31	175	33	I	18	38
32	65	33	0		43
33	No reduction	25	0		47
34	204	29	0		30
35	No reduction	45	E	0	42
36	165	37	0		28
37	309	27	0		30
38	279	56	E	16	25
39	384	37	0		32
40	68	24	0		25
41	467	70	E	18	40
42	672	53	E	24	37
43	66	123	E	24	34
44	88	36	0		32
45	452	71	E	0	55
46	495	36	E	14	25
47	95	50	0		15
48	45	34	E	24	23
49	90	43	0		34
50	264	37	0		41

*The Wassermann reaction was negative with the following exceptions: Case 18, 3+; Case 26, 2+; Cases 30 and 46, 1+; Case 34, 4+.

†I, intra-oral drainage; E, extra-oral drainage.

from 4 months to 19 years averaged 5.4 mg. of phosphorus per hundred cubic centimeters of serum, while those from 20 to 44 years averaged only 3.8 mg. of phosphorus. Howland and Kramer arrived at the same phosphorus average in children. Tisdall and Harris then studied eleven cases of fractures in patients from 20 to 79 years of age. The blood was obtained in most cases from two to six weeks after the fracture and, in all the cases, there was clinical or roentgen-ray evidence of union. The calcium content was increased but slightly above the normal of 10 mg. per hundred cubic centimeters, while the phosphorus increased from the adult average of 3.8 to 5.3 mg. for each hundred cubic centimeters of serum.

Their conclusions were as follows:

1. The inorganic phosphate content of normal serum from birth to 20 years of age is remarkably constant. At this age, it drops sharply to a lower level and is again remarkably constant at this lower concentration throughout adult life.

2. The drop in the phosphate content of the serum at the age of 20 corresponds to the period of cessation of bone growth.

3. During the period of union of fractures in adults, the phosphate content of the serum is raised to a level approximately the same as that present in childhood, i.e., the period of active bone growth.

4. There is a close parallelism between the concentration of inorganic phosphate in the serum, and the deposition of new bone, during both the period of growth and the period of repair of fractures.

5. In addition to the increase which occurs in the organic phosphate content of the serum during the union of fractures, there is also a local metabolic process even more important for the production of union than the increased phosphate content of the serum.

Their conclusions lead one to believe that the phosphorus and not the calcium is the important element in the union of fractures.

D. What effect does the feeding of calcium products have on the phosphate content?

Tisdall and Harris[9] also showed that the feeding of phosphate produced a decrease in the blood calcium.

McCollum, Simmons, Shipley and Park[10] found that, when a diet high in calcium and low in protein is fed to rats, the absorption of calcium is improved while that of phosphorus is impaired. Howland and Kramer,[11] in studying rats on this diet, observed that the concentration of calcium in the serum is raised and that of the inorganic phosphorus is lowered. They further contend that the administration of calcium salts to man by mouth or hypodermically may correct deficiency in calcium but cannot materially raise the calcium content above normal.

Nature maintains a balance. If one element is raised, the other is lowered. In fracture cases, the phosphorus seems to be the important factor. It would be logical to assume that the indiscriminate feeding of calcium preparations in any case in which the deposition of lime salts is desired would be useless and even dangerous.

STATEMENT OF THE PROBLEM

Most studies of fractures of the man-

10. McCollum, E. V.; Simmonds, Nina; Shipley, P. G., and Park, E. A.: J. Biol. Chem., 51:41-49 (March) 1922.

11. Howland, John, and Kramer, Benjamin: Factors Which Determine Concentration of Calcium and of Inorganic Phosphorus in Blood Serum of Rats, Am. J. Dis. Child., 22:105-119 (Aug.) 1921.

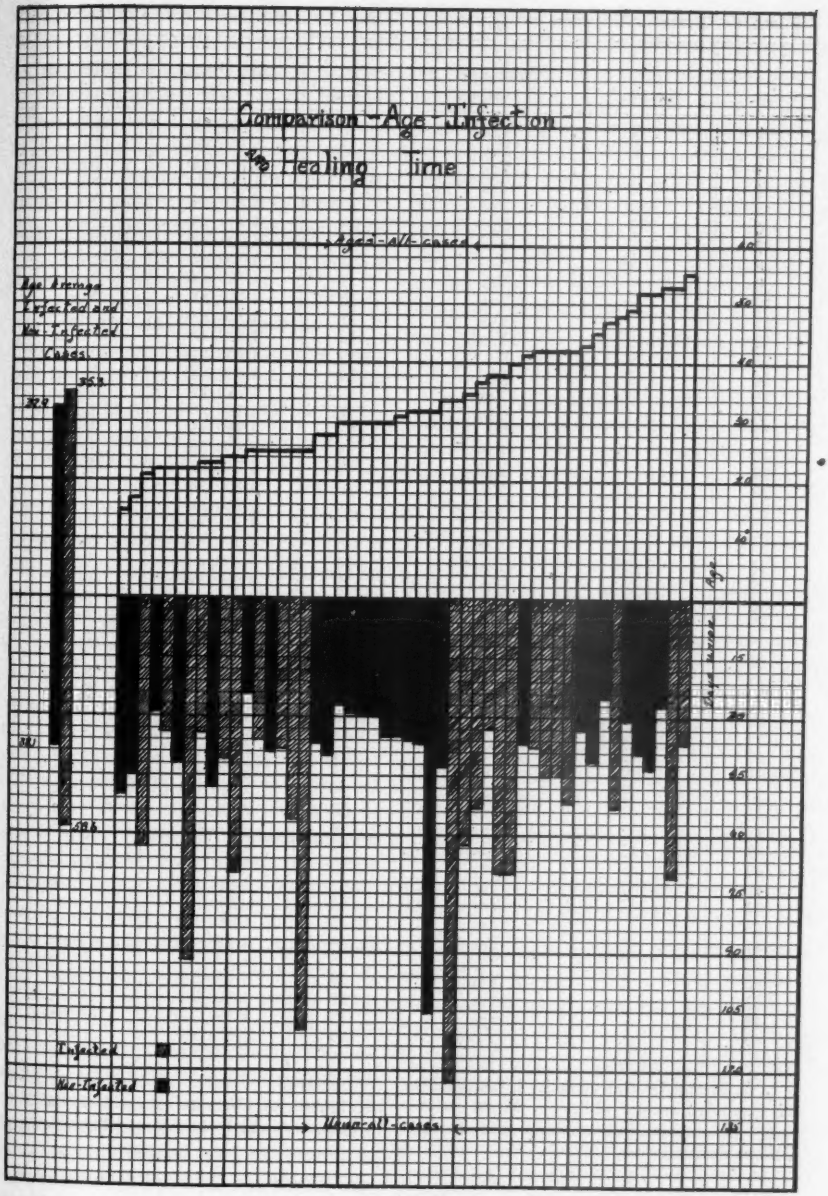
Comparison—Age—Infection
& Healing Time
Ages—all cases
Age Average Infected and Non Infected Cases
Infected
Non-Infected
Means all cases

Fig. 1

TABLE 6.—TYPES OF FIXATION AND RESULTS

Case	Fixation*	Anatomic Reposition
1	2 G	Yes
2	S	Yes
3	L	Yes
4	2 G	Yes
5	2 G	Yes
6	2 G	No
7	2 G	No
8	2 G	No
9	S	Yes
10	L	Yes
11	L	Yes
12	L	Yes
13	N	No
14	2 G	No
15	L	Yes
16	2 G	Yes
17	N	No
18	2 G	Yes
19	2 G	Yes
20	L	No
21	L	Yes
22	2 G	No
23	2 G	Yes
24	2 G	Yes
25	2 G	No
26	2 G	Yes
27	2 G	Yes
28	L	Yes
29	L	Yes
30	L	Yes
31	2 G	Yes
32	L	Yes
33	N	Yes
34	2 G	Yes
35	N	Yes
36	L	Yes
37	L	Yes
38	C	Yes
39	C	Yes
40	L	Yes
41	2 G	Yes
42	2 G	Yes
43	L	Yes
44	C	Yes
45	C	No
46	L	Yes
47	2 G	Yes
48	L	Yes
49	L	Yes
50	L	Yes

*2 G, second Gilmer method; L, loop method (modified second Gilmer); N, no reduction; C, combination of loop and second Gilmer methods.

TABLE 7.—RED BLOOD COUNT AND URINALYSIS*

Case	Red Blood Count	Urinalysis for Sugar
1	4,840,000	None
2	4,350,000	None
3	4,720,000	None
4	4,510,000	None
5	4,110,000	None
6	4,230,000	None
7	4,600,000	None
8	4,700,000	None
9	4,700,000	None
10	4,150,000	None
11	4,320,000	None
12	4,350,000	None
13	4,900,000	None
14	5,330,000	None
15	4,740,000	Trace
16	4,620,000	Trace
17	4,740,000	Trace
18	4,860,000	Trace
19	4,250,000	Trace
20	4,100,000	Trace
21	4,240,000	Trace
22	4,520,000	Trace
23	4,250,000	Trace
24	4,230,000	Trace
25	4,610,000	Trace
26	4,520,000	Trace
27	5,150,000	Trace
28	4,550,000	Trace
29	5,350,000	2+
30	4,500,000	None
31	5,050,000	None
32	4,850,000	2+
33	4,100,000	None
34	4,150,000	None
35	3,900,000	None
36	5,210,000	None
37	5,020,000	None
38	4,950,000	None
39	4,350,000	Trace
40	4,150,000	None
41	5,450,000	None
42	5,350,000	None
43	4,640,000	None
44	4,810,000	None
45	4,390,000	None
46	5,100,000	None
47	4,510,000	None
48	4,350,000	None
49	4,810,000	None
50	5,200,000	None

*Urinalysis revealed no casts and a trace of albumin in all cases except 1, 2 and 5 to 13 inclusive, which showed no albumin.

dible have been concerned with the factors involved in the success of healing, including the matter of time of healing and the results obtained. In the present investigation, an attempt has been made to study all these factors, but as some of them have already been thoroughly investigated, most attention is given to the effects of delay before reduction; infection, syphilis, and blood calcium and phosphorus metabolism.

MATERIALS AND METHODS

Approximately fifty consecutive cases were studied. At the beginning of this work, it was necessary to draft a special chart, which was used on each case and on which all the records of that particular case were kept.

The majority of patients with fractures were admitted to the hospital; a few were treated in the out-patient department. They were first thoroughly examined and their charts filled out. The patients were then sent for confirmation of the diagnosis by roentgenograms. The reduction of the fracture was accomplished as soon as possible after admission. In some cases, this was at once; in others, because of edema, infection or shock, it was delayed until such time as was deemed advisable. Many of the patients came in days, weeks and, in one or two cases, months, after the injury. Several infected cases had been previously handled by other men. At the time of reduction, a notation was made as to the site and kind of fracture and the bone involved, the number of hours elapsing between injury and reduction, whether anatomic reposition was obtained and the anesthetic and type of wiring used. It might be well to note here that in the great majority of our cases, the fractures were reduced under local anesthesia, our routine treatment being as follows: One and a half hours before reduction, the patient was given a hypodermic injection of morphin sulphate, one-sixth grain, and scopolamin, one one-hundred-and-fiftieth grain. This was repeated one hour later or one-half hour before reduction. This combination quiets the patient, drys up the flow of saliva, making for easier wiring, and alleviates to a great extent the pain resulting from the manipulation of the parts. Whenever necessary because of great displacement or intense pain, a mandibular block was made on the affected side or sides.

On the same day, white and red blood counts and a differential blood smear were made. The white counts were repeated, as nearly as possible, at weekly intervals, and were made at approximately the same time of day, because of a rhythmic rise and fall.[12]

Standard U.S.P. pipets were used for all counts and the same one was used on each case. For the white counts, the blood was diluted with a 1 per cent solution of acetic acid, mixed by shaking for five minutes, and the count then made from the fourth or fifth drop from the pipet. A standard Bosch and Lomb counting chamber was used, the four large corner squares being counted, and the total being multiplied by 50. In many cases, two counts were made at each time to check the possibility of error.

The red blood count specimen was diluted with a standard Hayem's solution, mixed, and the count made from five scattered small squares of the chamber, the resulting total being multiplied by 10,000.

12. Harvey, H. E.; LaFevre, H. B.; Heselton, S. P.: Blood Cell Counts in Dental Infections and the Derivation from Them of a Numerical Health Index, J.A.D.A., 13:331 (March) 1926.

TABLE 8.—LEUKOCYTE COUNTS (INFECTED CASES; EXTRA-ORAL DRAINAGE)

Case	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week	7th Week	8th Week	9th Week	10th Week	11th Week	12th Week	13th Week	14th Week	15th Week
6	13,250	10,900	10,300	14,350	9,550	9,100	8,250								
7	7,650	6,400	5,950	7,000	7,700										
10	9,900	9,850	9,600	7,400	10,100	8,900									
11	10,500	9,050	9,800	7,800	7,950	7,800	9,450	8,500	7,950						
15	10,350	12,100	9,750	9,600	12,800	11,250	11,300	9,250	8,600						
17	13,800	13,600	10,100	10,300	10,250	9,750									
18	9,950	13,950	11,400	12,900	11,850	9,750	8,950								
25	10,150	9,850	9,600	9,450	9,700	8,750	8,800								
26	9,000	16,850	18,900	14,250	8,900	7,800	8,500	8,600	8,850	8,300	8,550	8,400	8,150	8,300	8,250
28	8,850	11,850	8,450	8,550	7,550	7,600									
35	14,300	10,800	10,300	9,150	8,650	8,800									
38	12,300	10,400	10,000	9,850	9,750	8,200	7,100	7,350	7,150	7,200					
41	9,950	9,450	9,700	10,200	9,400	9,200	8,750	9,600	8,800						
42	9,450	9,200	8,750	8,800	8,600	8,850	8,500	8,350							
43	14,350	12,100	9,950	12,350	15,300	9,700	8,900	8,450	8,350	8,400	8,150	8,250			
45	9,100	8,750	8,500	7,900	7,350	5,300	6,100	6,350	6,400	5,850					
46	7,800	7,300	8,300	8,200	8,000	7,900									
48	18,100	12,300	9,350	10,250	8,700	8,400									
Total:	192,700	194,700	178,700	178,300	172,100	147,000	94,600	65,450	56,100	30,750	16,700	16,650	8,150	8,300	8,250
Average:	11,040	10,820	9,928	9,905	9,560	8,765	8,600	8,180	8,010	7,690	8,350	8,325	8,150	8,300	8,250

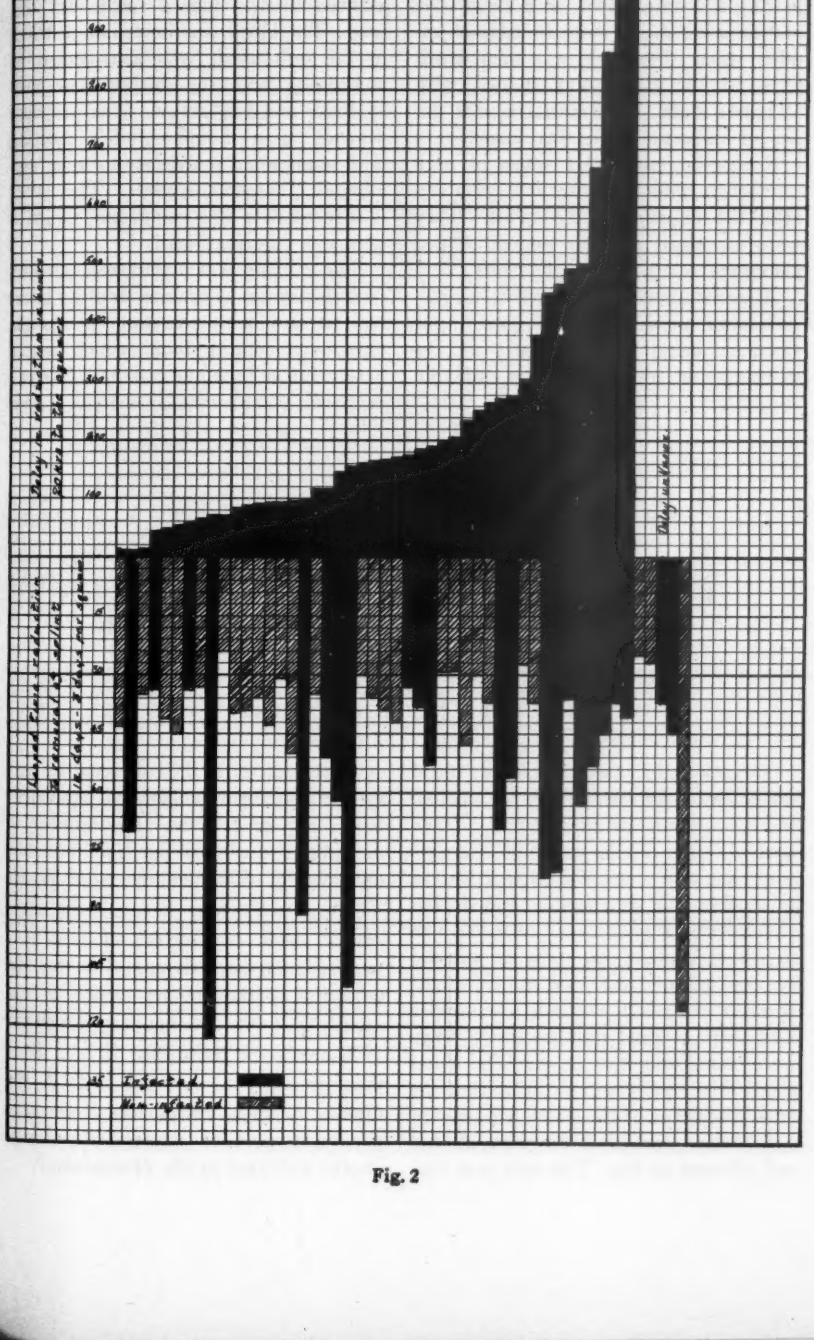

Fig. 2

The differential smear was made by placing a drop of blood on a clean slide and drawing it out with the edge of another slide. The slide was then dried, fixed in the flame and stained with Wright's stain. Differential counts under oil immersion were then made.

Roentgenograms were taken of each case before reduction, after reduction and after the removal of the splint. They were examined and the degree of displacement was noted on the chart.

A urinalysis was made as soon as possible after admission of the patient, the specimen being obtained early in the morning and tested for sugar, albumin and casts.

TABLE 9.—LEUKOCYTE COUNTS (INFECTED CASES; INTRA-ORAL DRAINAGE)

Case	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week	7th Week	8th Week	9th Week
3	12,400	12,250	10,600	10,800	13,150	9,700	6,550	6,750	
16	6,500	6,850	6,600	7,000	7,150	7,050	6,950	6,850	6,900
19	17,750	8,850	7,950	8,100	8,000	7,500	7,650		
24	11,850	11,500	8,900	9,500	9,350	11,800	9,200	7,600	
31	11,150	10,300	11,500	10,650	9,350	8,650			
Totals	59,650	49,750	45,550	46,050	47,000	44,700	30,350	21,200	6,900
Averages	11,930	9,950	9,110	9,210	9,400	8,940	7,587	7,067	6,900

Twenty cubic centimeters of blood was drawn from each patient for calcium and phosphorus determinations. These were all taken in the morning at a definite time and a definite technic had to be worked out in cleaning and drying instruments to avoid contamination. The phosporus content can easily be affected by any minute substance which might affect the color of the serum. The needles used were 21 gage stainless steel. They were boiled and then dried. The blood was drawn from the cephalic vein of the arm. The flexor of the elbow was painted with iodin, washed clean with alcohol and allowed to dry. The vein was then entered with the dry needle and the blood allowed to drip into a sterile dry test tube. The blood was immediately taken to the technician, who analyzed it in accordance with the method developed by Fiske and Subbarrow. The principal depends upon the phosphate's reacting with ammonium molybdate to form ammonium phosphomolybdate. The latter is reduced to a blue compound, which is estimated colorimetrically.

The calcium was precipitated directly from the serum as oxalate, and the latter was titrated with potassium permanganate to a definite pink, which would persist for at least one minute. The calculations were made as follows: One cubic centimeter of 0.01 per cent of normal potassium permanganate is equivalent to 0.2 mg. of calcium. The number of milligrams of calcium per hundred cubic centimeters of serum therefore equals $\frac{100 \times 0.2X}{2} = 10X$ where X equals the number of cubic centimeters of $KMNO_4$ required. A correction is made for the potassium permanganate which is not exactly 0.01 N. The figure by which the 10X has to be multiplied is $\frac{25}{21.6}$. It is then necessary to subtract from X the number of cubic centimeters of permanganate required to titrate 2 c.c. of sulphuric acid used in the determinator.

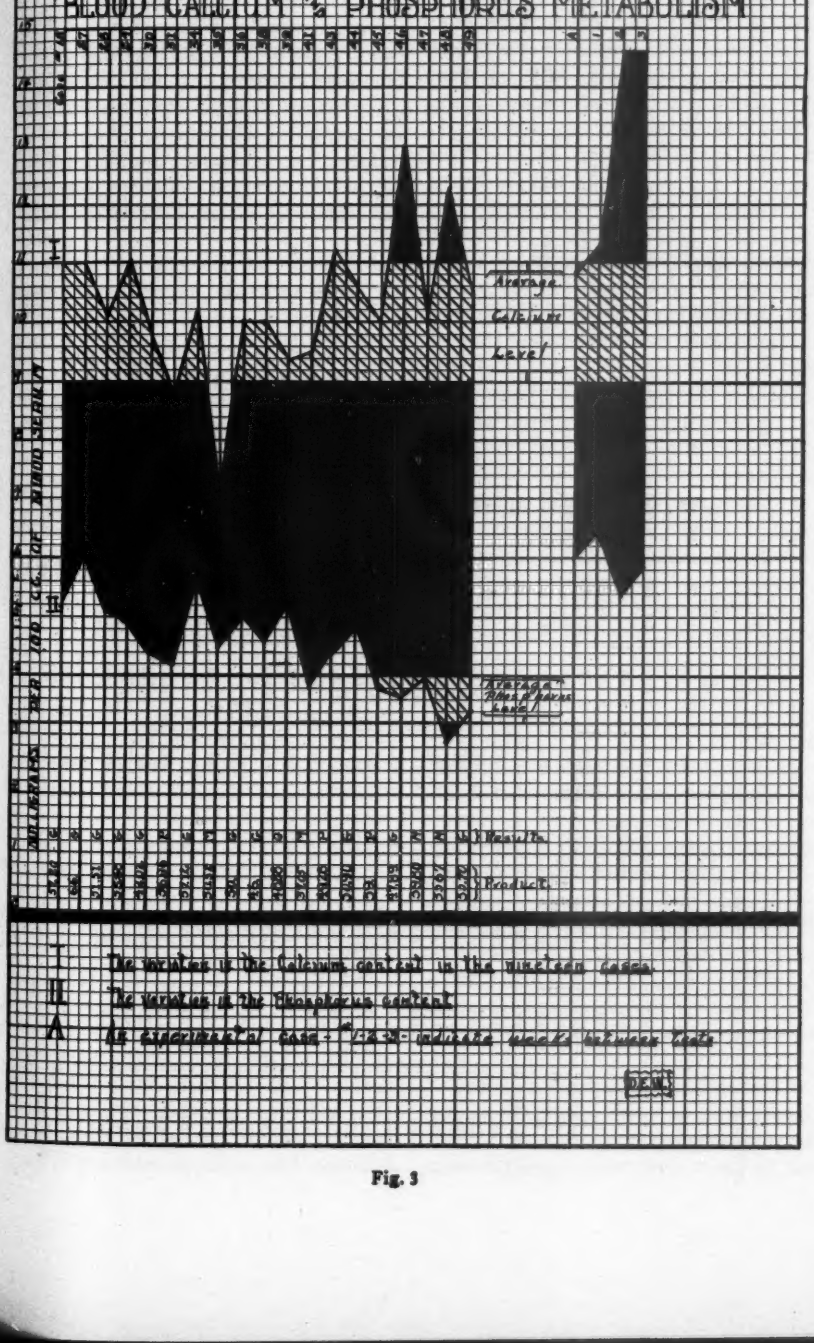
BLOOD CALCIUM & PHOSPHORUS METABOLISM
Average Calcium Level
Average Phosphorus Level
Milligrams per 100 c.c. of Blood Serum
Milligrams
Weeks
Product
I The variations in the Calcium content in the Clinical Cases.
II The variations in the Phosphorus content.
A Experimental Case: 1-2-3- indicate blood withdrawn tests
DEW

Fig. 3

TABLE 10.—LEUKOCYTE COUNTS (NONINFECTED CASES)

Case	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week	7th Week	8th Week	9th Week	10th Week	11th Week	12th Week	13th Week
1	14,900	10,400	9,850	11,150	11,050	10,500	8,650						
2	15,900	11,150	8,900	9,000	8,560								
4	11,100	10,250	9,450	13,100	10,100	8,300	6,150	4,300					
7	12,150	10,250	9,950	9,400	8,950	10,000	8,700	8,400	8,150	8,250	7,850	8,150	8,900
8	16,950	13,300	15,550	10,300	10,800	10,800	11,250						
9	9,900	10,850	13,450	10,300	10,150	16,600	10,900	10,350	10,100	9,850	9,250	9,750	
12	6,350	6,000	11,100	9,400	7,250								
13	8,950	9,350	6,050	6,500	6,350								
14	7,500	7,650	6,350	6,850	7,100								
20	9,650	8,800	10,600	10,350	9,500	9,150	8,550						
21	9,850	9,900	9,400	9,050	8,850	9,000							
22	13,500	9,200	7,800	8,500	9,050	9,450	8,850						
23	8,150	6,350	6,750	6,650	6,750	7,100	7,250						
27	10,500	9,900	9,350	8,600	8,400								
29	13,050	12,850	12,400	11,200	11,100								
30	11,050	11,350	10,450	9,950	9,400	9,000							
32	9,600	8,900	8,050	7,850	7,600								
33	10,150	8,150	8,200	7,850	7,800								
34	12,050	12,150	12,250	11,300	10,850								
36	11,000	11,250	11,350	10,250	9,300	9,150							
37	8,950	8,450	8,500	8,350	8,550								
39	12,500	11,150	12,100	13,600	10,300	8,750	8,550						
40	12,000	7,550	7,300	6,450									
44	11,250	10,350	9,600	9,100	8,750	8,500							
47	6,650	6,800	6,450	9,300	8,700	6,800	6,750						
49	7,200	6,750	6,700	6,850	6,800	6,600	6,700						
50	18,200	13,500	10,100	9,300	9,100	8,750							
Totals:	299,000	262,550	258,000	250,500	231,200	148,450	92,300	25,050	18,250	18,100	17,100	17,900	8,900
Average:	11,047	9,724	9,555	9,276	8,892	9,965	8,390	8,350	9,125	9,050	8,550	8,950	8,900

CLINICAL RECORDS

The clinical evidences of infection were followed, and notations were made from time to time. If drainage was established, the type, whether intra-oral or extra-oral, was noted on the chart.

When the patient was discharged, the final results were estimated and classified as good, moderate or poor, under the three headings: anatomic, functional and union.

When the accumulation of data had been completed on the fifty cases, the cases were numbered according to date of admission and the various records were entered in the accompanying tables (Tables 3-14). From these, graphs have been made to illustrate more clearly than words the findings in the individual and collective cases.

COMMENT

The relationship of jaw fractures to the various factors heretofore mentioned presents many different classifications. I do not intend to discuss, except briefly, the etiologic and other factors which have but little effect on the healing process and infection of fractures. Previous reports have given us adequate classifications of these factors. It is my aim to augment these previous reports with a discussion of the clinical and laboratory findings which might influence infection and the healing process.

1. *Simple Fractures* (Table 3).—Eight cases, or 16 per cent, were simple fractures. One out of the eight developed infection. (One case included in the series was an ununited fracture of two and a half years' duration which was later operated on. The end result in this case, therefore, will not be considered under simple fractures.) Of the other seven cases, the average healing time was thirty-five days or three and one-tenth days less than the average for all noninfected fractures. The results were as follows: anatomic, good, four; moderate, two; poor, one; functional, good, three; moderate, four; union, good, four; moderate, two; poor, one. No result was classified as good unless the end result, when the wires were removed, was as nearly ideal as possible.

2. *Compound Fractures* (Table 3).—Forty-two, or 84 per cent, were compound fractures. Of this number, twenty-two (52.4 per cent) were infected and twenty (47.6 per cent) noninfected. The average healing time was forty-seven and four-tenths days, or twelve and a half days longer than was necessary for simple fractures. The average healing time necessary for infected compound fractures was fifty-eight and five-tenths days, while the noninfected compound fractures required only thirty-seven days. The results (Table 14) were as follows: anatomic, good, twenty-five; moderate, thirteen; poor, four; functional, good, twenty-three; moderate, nineteen; union, good, twenty-five; moderate, thirteen; poor, four.

3. *Single, Double and Triple Fractures* (Fig. 3, *6;* Table 3).—Of the twenty-eight single fractures, eight were simple and twenty were compound. No double or triple fractures in the series were simple. Of the single fractures, fourteen were infected; fourteen, noninfected. The healing time was forty-eight days. Of the double fractures, nine were infected; twelve, noninfected. The healing time was forty-six and nine-tenths days. In the single case of triple fracture, the healing time was twenty-nine days.

Union in the single infected cases required fifty-eight days; in noninfected, thirty-nine days. In the double infected cases fifty-eight days were required for

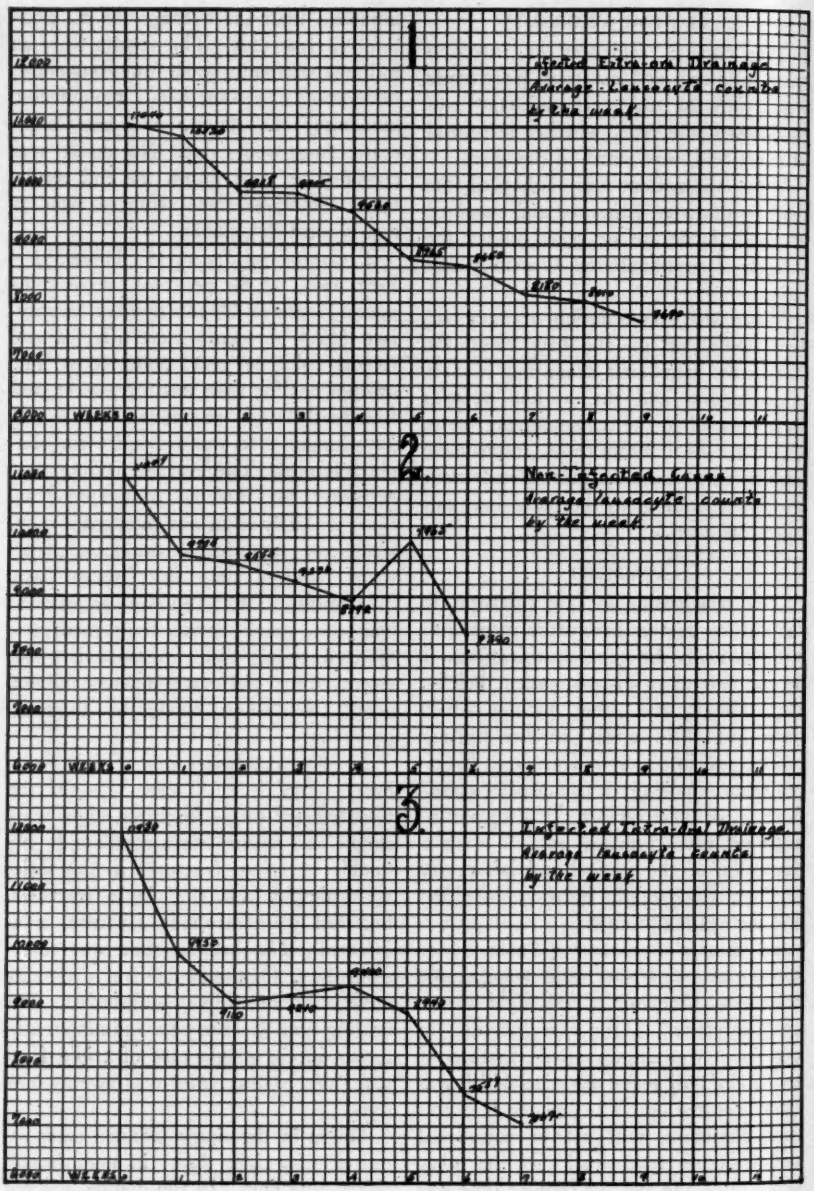
1
Injected Extra-oral Drainage
Average Lengths counts
by the week
WEEKS
2
Non-Injected Extra-oral
Drainage Lengths counts
by the week
WEEKS
3
Non-Injected Intra-oral Drainage
Average lengths counts
by the week
WEEKS

Fig. 4

TABLE 11.—DIFFERENTIAL COUNTS

Case	Lympho-cytes	Polymorpho-nuclears	Eosino-phils	Basophils	Transitionals	Large Mono-nuclears
1	27	64	3		1	5
2	29	68	1		2	
3	35	61	2	1	1	
4	32	64	3			
5	30	64	2	1	2	1
6	43	55	2			
7	25	73				2
8	39	56	2	2	1	
9	37	54	3	2	1	3
10	56	43		1		
11	37	59		1	1	2
12	34	62	2	1		1
13	45	51	1	1	2	
14	35	60	2			3
15	35	64				1
16	33	65			1	1
17	32	60	2		6	
18	31	64		1	2	2
19	31	69				
20	28	60	5	4	3	
21	34	62	2	1		1
22	30	64			4	3
23	36	58	4	2	1	1
24	42	56	1		1	
25	42	57				1
26	43	50	3	1		3
27	48	46	1	1	4	1
28	30	64	2	1	3	
29	33	60	1		2	4
30	36	62	1		1	
31	41	55	4			
32	30	67	1	2		
33	25	70		3	2	
34	23	71	2	6		1
35	28	65	1		6	
36	33	63		1	2	1
37	36	60	2	1	1	
38	30	65	1	1	3	
39	42	56			2	
40	31	58	5	2	4	
41	36	57	2	4	1	
42	30	64			2	4
43	48	49	3			
44	36	60	2	1	1	
45	54	43	1		2	
46	32	65	1	2		
47	34	60	1	2	2	1
48	26	69	1	3	2	1
49	31	65		1	2	1
50	29	61	4	1	4	1

union; in the noninfected, thirty-eight and five-tenths days. In the case of triple fracture, union took place in twenty-nine days. The healing time regardless of whether the fracture is single or double takes place in about the same length of time. It so happened in this series that single fractures showed a greater percentage of infection than double fractures. From this, we cannot conclude that these cases are more susceptible to infection but that factors other than the number of breaks influenced the result, such as trauma, hygienic conditions and the physical condition of the patient.

Results were as follows: single, good, fourteen; moderate, nine; poor, four; nonunion, one; double, good, fourteen; moderate, six; poor, one; triple, good, one.

4. *Syphilis* (Fig. 1; Table 5).—The healing time for syphilitic fractures was one and nine-tenths days more than the average for all cases. Various statements have been made, but no work could be found to confirm them, concerning the effect of syphilis on the healing of jaw fractures. Though five cases do not give positive proof yet, in the face of no evidence at all, it is at least indicative that there was an average healing time. Only one case out of five presented any great difficulty, the average healing time of the other four being under that of noninfected fractures.

The results were: anatomic, good,

TABLE 12.—BLOOD CALCIUM AND PHOSPHORUS CONTENT

Case	Phosphorus (Per 100 C.c. Serum)	Calcium (Per 100 C.c. Serum)	Product
18	5.20	11.0	57.20
27	6.00	11.0	66.00
28	5.10	10.1	51.51
24	4.88	11.0	53.68
30	4.40	9.8	42.02
31	4.20	8.8	36.96
34	5.60	10.2	57.12
35	4.44	7.1	30.52
36	5.00	10.0	50.00
38	4.60	10.0	46.00
39	5.20	9.4	48.88
41	3.90	9.5	37.05
43	4.40	11.2	47.04
44	4.84	10.6	50.90
45	3.90	10.0	39.00
46	3.68	13.0	47.89
47	3.98	10.0	39.80
48	2.90	12.3	35.67
49	3.40	10.5	35.70
Averages	4.47	10.36	46.36
Case A:	6.0	10.8	64.80
1 week	6.4	11.3	72.32
2 weeks	5.38	14.5	78.01
3 weeks	5.82	14.5	84.09

four; moderate, one; functional, good, three; moderate, two; union, good, four; poor, one. The results obtained in syphilitic fractures are as good as the average, if not a little better. That the presence of a positive Wassermann reaction without mouth lesions interferes with the healing process cannot be demonstrated.

5. *Age* (Fig. 1; Table 5).—The infected and noninfected cases were divided as follows: age, 10-20, infected, none; noninfected, two; 20-30, infected, ten; noninfected, seven; 30-40, infected, five; noninfected, ten; 40-50, infected, six; noninfected, five; 50-60, infected, two; noninfected, three.

TABLE 13.—ROENTGEN-RAY EVIDENCE OF DISPLACEMENT

Before Reduction			After Reduction			After Removal of Splint		
None Case	Slight Case	Marked Case	None Case	Slight Case	Marked Case	None Case	Slight Case	Marked Case
3	1	2	1	2	13	1	2	8
10	4	7	3	6		3	6	13
11	5	8	4	7		4	7	19
23	6	13	5	8		5	9	43
30	9	14	10	9		10	14	
32	12	16	11	14		11	16	
33	15	19	12	16		12	20	
40	17	20	15	17		15	22	
	18	22	18	22		18	25	
	21	24	19	25		21	26	
	28	25	21	26		23	31	
	29	26	23	31		24	39	
	31	27	24	39		27	41	
	34	43	27	41		28	43	
	35	44	28	43		29	44	
	36	45	29	44		30	45	
	37	47	30	45		32	50	
	38	48	32	50		34		
	39	50	34			36		
	41		36			37		
	42		37			38		
	46		38			40		
	49		40			42		
			42			46		
			46			47		
			47			48		
			48			49		
			49					
Total No. Cases: 8	23	19	28	18	1	27	16	4

*In the last two divisions, three cases are missing as they were not reduced and therefore no record was kept.

The two columns on the left hand side of Figure 6 show the average age in infected and noninfected fractures. Such a small difference would lead us to believe

that the age factor is an unimportant one in the face of infection.

6. *Delay in Reduction* (Fig. 2; Table 5).—In five cases, the delay was unknown. Averages of the different classes show that in the badly infected case, there is the greatest delay; while in the noninfected cases, there is the least. When the delay is not associated with infection, it has no effect on the healing time. Of twenty-eight cases with less than 200 hours' delay, eleven were infected, six of which required more than the average healing time of all fractures. On the other hand, seventeen cases were noninfected and in only one case was the healing time longer than the average. Of the seventeen cases of more than 200 hours' delay, ten were infected, six of which required more than the average healing time of all fractures. Seven were noninfected and only one of those took longer than the average healing time.

From these facts, it is evident that the only effect which delay has on healing time is through the greater liability to

TABLE 14.—RESULTS

Anatomic Results			Functional Results			Union		
Good	Moderate	Poor	Good	Moderate	Poor	Good	Moderate	Poor
1	6	8	1	6		1	3	13
3	2	13	2	7		2	6	26
4	7	19	3	8		4	10	31
5	9	35	4	9		5	14	43
10	14	43	5	10		7	15	45
11	16		11	13		8	16	
12	17		12	14		11	17	
15	20		21	15		12	19	
18	22		22	16		18	25	
21	25		23	17		20	35	
23	26		24	19		21	41	
24	31		27	20		22	42	No Union
27	39		28	25		23	47	
28	41		29	26		24	48	9
29	50		30	31		27	50	
30	44		32	35		28		
32			33	37		29		
33			34	41		30		
34			36	42		32		
36			38	43		33		
37			39	44		34		
38			40	48		36		
40			46	50		37		
42			47			38		
46			49			39		
48			45			40		
47						44		
49						46		
45						49		
Total No. Cases:								
29	16	5	26	24		29	15	1 5

infection which it causes; for when infection is present, a delay of more than 200 hours is associated with more than average healing time in no greater proportion than a delay of less than 200 hours.

All cases with more than 400 hours' delay were infected. Of the cases with more than 200 hours' delay, 58.9 per cent were infected, as compared with 40.7 per cent infected cases with less than 200 hours' delay.

Delay is a factor which should be eliminated as much as possible, but it is not so serious as to demand emergency treatment in every case. The earlier reduction is instituted, the less the possibility of infection, and consequently the shorter the healing time.

7. *Methods of Reduction.* — As the splint was used in only two cases, the results should not be taken as an indication that the splint is the most successful means of fixation. The higher percentage of infection in cases wired by the second Gilmer method is also not an indication that the method is at fault, but can be explained by the fact that the loop method was used on only the favorable cases, while the second Gilmer method was used on the difficult ones. (The loop method referred to here is a modification of the original second Gilmer method.) No one method can be used to the exclusion of all the others. They all have their place in the reduction of jaw fractures.

8. *Infection.*—Of all the fractures of bones throughout the body, there are none which present such a high rate of infection as those of the mandible. The results from this series show an average of 46 per cent infected cases. (Table 4.) Other investigators have reported from 15 to 30 per cent infection in jaw fractures. In jaw fractures, as a rule, patients are not kept in the hospital more than a week; while, on the other hand, infection does not appear until the second or third week, as evidenced clinically by localization and drainage. (Table 5.) It is true that cases show evidences of infection before this time by edema, rise of temperature and pain, but it cannot be said definitely that infection is present until drainage is established. Thus, many cases may be reported as not infected which later become so. A true report cannot be made unless the case is personally handled from beginning to end. There were three cases in the series which ran an uneventful course until after the wires were removed and then showed symptoms of infection. I do not believe that our treatment was at fault but that these results show the true average of infection which can be expected in jaw fractures.

TABLE 15.—RESULTS IN INFECTED AND NONINFECTED CASES

	Anatomic		Functional		Union	
	Infected	Noninfected	Infected	Noninfected	Infected	Noninfected
	(Per Cent)		(Per Cent)		(Per Cent)	
Good	52.2	63.0	30.4	70.3	30.4	31.5
Moderate	34.8	29.6	69.6	29.7	52.2	14.8
Poor	13.0	7.4	...	...	17.4	3.7

Infection plays a big part in the delay of healing of a fracture of the jaw. The statement of Speed that jaw fractures heal in from four to six weeks in the presence of infection was borne out in a very few cases, but, in the great majority, a longer time was necessary. In no infected case were the wires removed in the shortest possible time. They were kept in place as long as the drainage kept up. Some writers advise the early re-

moval of wires and splints, and no doubt this procedure works favorably in their hands. I felt that the longer the fracture was reduced in the presence of infection the greater the chance Nature had of repairing the defect. In all noninfected cases, the wires were removed as soon as bony union was felt to be present.

Infection in jaw fractures is primarily due to the fact that 84 per cent of the fractures are compound. By far the greatest number are compounded into the mouth, which is notorious for its flora. Trauma, delay in reduction and lack of care after reduction are other factors which contribute to infection. Table 15 shows the results in infected and noninfected cases.

The anatomic results in the majority of both infected and noninfected cases were good, though the percentage was in favor of the noninfected cases. The functional results in the majority of the noninfected cases were classified as good, while in the majority of infected cases they were classified as moderate.

As to union, the same results were found, although the difference here is more markedly in favor of the noninfected cases. Infection has its greatest effect on the union of a fracture and the least effect on the anatomic result.

9. *Blood Calcium and Phosphorus Content* (Fig. 3; Table 12).—Acceptable results were obtained in nineteen cases. Of these nineteen cases, three had poor union, and in all the cases except one the product was above the norm of 35 as designated by Peterson. In two cases it was under 40. The case below 35 was a fracture of the zygoma and maxilla which, without reduction, showed evidences of moderate union in forty-five days. The results are in accordance with the conclusions of Tisdall and Harris that the phosphorus content is raised during the period of fracture, the phosphorus average of all cases being 4.47 mg. per hundred cubic centimeters of blood. These were all adult cases, and this figure is somewhat higher than the average at which several investigators have placed the phosphorus content for adults. The average of 10.36 mg. per hundred cubic centimeters for the calcium content shows little or no increase over the accepted average.

An experiment was tried in a separate case not included in the original fifty cases. (Case A, noted at the end of Table 12.) D. T., a man, aged 39, came in with an ununited fracture of two years' duration. Operation was performed by J. E. Schaefer and the ends of the bone were wired together, holes being drilled throughout the original fragile callus to stimulate osteogenesis. A blood calcium test was made three days after the operation and also at the end of the first week. The product is noted to be quite high in both of these tests. After the second test was made, the patient was placed on calcium lactate, 15 grains, three times a day for one week, and a third test was made. It will be noted that there was an increase in the calcium content and a decrease in the phosphorus. He was then given quartz light treatments and cod-liver oil in addition to the calcium lactate. At the end of the third week another test was made, and it was found that the calcium had remained the same, while the phosphorus content had regained some of its loss. This treatment was continued, and at the end of two months this patient had firm union in the line of fracture.

10. *White Blood Counts* (Tables 3-4).—The results of the white blood counts were divided into three classes: (1) cases requiring extra-oral drainage, eighteen; (2) cases requiring intra-oral

drainage, five; (3) noninfected cases, twenty-seven.

Practically all cases showed an increase in the white cells at some stage of the healing, but it could not be explained clinically in the noninfected cases, and it was not coincident with the localization in the infected cases. Some of the worst infected cases showed the least leukocytic reaction, and some of the noninfected cases showed a large leukocytic reaction at some stage of the observation. Figure 4 is a graph made of the averages of the different classes over the average period of time for union in the respective class. The infected cases did not average a higher leukocytic count than the noninfected cases. The severely infected cases show a gradual drop in the count from reduction to union. Infected cases with intra-oral drainage show some leukocytic reaction in the fourth week, while the noninfected cases show a considerable reaction in the fifth week following reduction. The only logical explanation of this is that it might be a defensive reaction. All results taken into consideration, the white count is of little value either experimentally or clinically in the treatment of fractures of the jaw.

11. *Roentgen-Ray Results.* (Table 13).—Roentgenograms revealed displacement before reduction as follows: none, eight; slight, twenty-three; marked, nineteen; after reduction, none, twenty-eight; slight, eighteen; marked, one; after the removal of the splint, none, twenty-seven; slight, sixteen; marked, four.

The results here are more or less self-explanatory. If the ideal reposition was not obtained, the case was classified as either slight or marked displacement. This accounts for our rather high percentage of slight displacements. In one case (19), a fracture of the angle, though no displacement showed after reduction, the posterior fragment, owing to the muscle pull and the angle of the fracture, later became displaced forward and united in this position. Marked displacement as the end result was usually due to great injury with loss of bone substance or a lack of sufficient teeth to immobilize the bone properly.

12. *Red Blood Counts.*—(Table 7.)—The red blood counts were all within average limits and of no value except as a check on the white blood counts.

13. *Urinalysis.*—(Table 7.)—Only two cases were with positive sugar and both healed without complications. Albumin and cast results were negative.

14. *Differential Blood Counts.*—(Table 11.)—The differential counts were all within average limits, though the average lymphocyte count might be considered a little high. Had these counts been made every week on each case, the nature of the infection might have been shown in the results, and would have possibly been of more value in a diagnosis of the type of infection than the white blood counts.

CONCLUSIONS

1. The most important factor in determining the healing time is infection of the fracture.

2. Other factors, such as type of fracture, age of patient, syphilis, delay in reduction and methods of reduction, influence healing time only as far as they predispose to infection.

3. Compound fractures are more liable to infection than simple fractures.

4. Delay in reduction is an important factor in predisposing a fracture to infection, especially when the delay is greater than 200 hours.

5. Infection is the greatest contributing factor in poor anatomic, functional and union results.

6. A rise in the phosphorus content of the blood follows a fracture.

7. The administration of calcium lactate probably raises the calcium content of the blood but has what seems to be a detrimental effect on the phosphorus content. When given in conjunction with cod-liver oil and quartz light irradiation, the effect on the phosphorus is probably not so marked.

8. Jaw fractures are followed by an immediate rise in the white blood count, due to tissue injury.

9. Severely infected cases, in the later stages of healing, show a relatively low white blood count.

10. Noninfected cases, in the later stages of healing, show a relatively high white blood count, which may be interpreted as a defensive reaction.

FITTING, PLACING AND MAINTENANCE OF CAST PARTIAL DENTURES*

By F. VAN MINDEN, D.D.S., Chicago, Ill.

THE fitting, placing and maintenance of cast partial dentures has received but scant attention in the dental literature. It seems that few, if any, writers have deemed it necessary to devote any time and thought to these phases of partial denture construction.[1] Nevertheless, the fact remains that, unless the dentist pays proper attention to these details, he cannot possibly hope to obtain the results to which the patient is entitled.

It may well be that the subject which we are to discuss is so well known to all dentists and the details of it are so nearly every one's property that nothing novel can be said about it. No attempt will be made in this paper to present anything that is not already in common practice among experienced practitioners; nor will it be possible to give a complete review of all conceivable points.

It occurs to me that an enumeration in their proper sequence of the most important details involved in the correct fitting and placing of partial dentures would not be amiss, and might contribute, in a small part at least, to the elimination of failures in cast partial denture work, which have been only too frequent in the past.

FITTING

For the purpose of this discussion, let us assume that a cast partial denture has been constructed by whichever method the individual operator may prefer, be it assembled or cast in one piece, made by a dental laboratory technician or himself, and that the case is now ready for the patient.

We first have to fit the denture properly to the mouth so that it goes to place perfectly without undue pressure on the abutments and soft tissues. If a master model has been used in the construction,

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1. Cummer, W. E.: Theory and Practice of Partial Denture Service, J. A. D. A., 9:735 (Sept.) 1922.

the denture should be fitted first to this model; which will save time at the chair, although the denture will still have to be fitted in the mouth. It is of the utmost importance that this fitting be done painstakingly, for no case can be successful unless it is properly seated.

To determine the perfect seating, we should begin by judging the amount of resistance that we feel on digital pressure when we attempt to place the denture in the mouth. If any obstruction is met, we should at once determine where it occurs and decide how to overcome it. If the obstruction is slight, we can usually press the denture to place with little force. If the obstruction is greater, it is usually due either to the fact that the denture presses somewhere against the teeth, because the clasps must be relieved around the gingival aspect, or that the bell-shape and tipping of the abutments prevent the clasps from slipping into place, both of which can be avoided by proper design and construction. If design and construction are not correct, it will be necessary to remove the areas of interference in the case and, in rare instances, on the abutments, through spot grinding, the operator always bearing in mind, of course, that the case must be relieved on the exact spot where there is contact with the teeth. This is sometimes difficult and tedious, especially if the places of contact are hidden or are not readily apparent to the eye.

It is in these cases that, frequently, a great deal of skill and experience are required to find the exact spot which needs trimming. The dentist who relies on laboratory construction is under a handicap here, for he has no personal knowledge as to how the case was constructed and what happened during construction; while the dentist who constructs his own dentures might easily remember what took place that might account for the difficulty. It is my belief that many of the so-called failures in cast partial dentures are due to inability and lack of patience on the part of the dentist in finding and removing the exact cause of the interference, with the result that the denture is not properly seated.

We can easily test the accuracy of the seating by determining whether the occlusal lugs of the clasps are exactly in the places provided for them, while, at the same time, there is perfect adaptation to the soft tissues. If we have carried the case through with due consideration for accuracy and detail, we usually have little trouble in seating the denture, although, occasionally, our difficulties might seem great. It has been found advantageous, in such instances, after some preliminary grinding has been done, to press the denture up with sufficient force to rub the gold against the abutments, in order to make a small shiny facet in the midst of an otherwise roughly ground surface. This facet is then readily detected and removed.

If a reasonable amount of fitting does not seat the denture properly, we should consider the possibility of a misfit. This may be due to a severe contraction in a one-piece casting as a result of a faulty heating or casting technic, or, in an assembled case, as a result of inaccurate assembling, with consequent warpage. Neither of these conditions can be easily remedied, and experience teaches that we had better reconstruct the case.

We should make certain, now, that there is no undue strain on either the teeth or the soft issues, and, to ascertain this, we ask the patient for his reactions. If the pressure is very noticeable, we will have no difficulty in obtaining a clear expression from the patient. As we remove the cause, and lessen the strain or pres-

sure, this will become harder to observe, and many patients become tired, both physically and mentally, in their powers of observation and preception. Moreover, many are ignorant of the end-result that we are trying to obtain and honestly believe that the case should feel the way that it does. These points are mentioned in order to emphasize that we should bear in mind from the start the psychologic factor in our work and consider the mental attitude of the patient. A mere grunt, a hesitant approval or a doubtful guess on the patient's part that the denture feels all right is not sufficient. We must receive an unqualified yes, given in a cheerful manner without faltering, preferably with a smile, before we may feel confident that the denture fits properly and is perfectly seated. It will be noted that patients will tolerate no bridge which depends on a wedging effect for its retention, and all such pressure must be entirely removed in the fitting process.

The next step is to correct the occlusion. The artificial teeth are placed in the denture and checked one by one for proper occlusion and articulation. It is understood, of course, that, prior to this, the case has been freed from any interference with the normal bite. The checking up of the porcelain teeth, as well as of the goldwork itself, is a normal routine procedure, well known to every dentist. Nevertheless, great care should be taken that no high spots are overlooked, and the patient's answer should be given in the same manner and received with the same precaution as was suggested in the fitting process. We should not consider our efforts successful if any interference is felt, and the final test lies in the removal of the denture from the mouth, which should leave the patient without any change in comfort. If no difference can be observed on placing or removing, by either patient or dentist, we can consider the denture properly fitted.

PLACING

The placing of the denture is now in order. The first requisite is, of course, that it must be capable of being seated, retained and removed without undue difficulty. No patient can be expected to use a partial denture happily if considerable effort and force is required for its removal or retention. Hence, we must see to it that the clasps are sufficiently eased, that they will readily release the abutments and, reversely, that they are sufficiently tight to clasp the abutments properly. It is well known that clasps are capable of a certain amount of latitude. Between the point where the denture is so tight that it will not go to place and the point where it is so loose that retention is lost, there is a happy medium.

The skilful dentist observes, in each instance, how far he can go in either direction without transgressing the boundaries of his patient's comfort and those of a properly fitting case. It is best to use a half-round plier with the round beak inside the clasp, if such changes are needed.

We now have to teach the patient how to handle the case, showing him the easiest way to place and to remove the denture. This we have learned from the preceding fitting process, and it varies in each case. As the denture is new and feels strange, we show the patient in the mirror how to go about inserting and removing it, and let him repeat this a few times till we are sure that he can handle it without embarrassment. Nothing would seem a greater reflection on our work in the mind of the outsider than a removable bridge which cannot be removed.

When the patient has learned how to handle the denture, we give him instruction in the care of it. In addition to the regular care of his teeth, strict orders are given to remove and brush the denture after every meal and to leave it out at night. If any objection is met on that score, we merely remind the patient of his promises to carry out these instructions, which, in my practice, were part of the agreement under which the case was constructed. If proper arrangements have been made beforehand, and the patient has a sufficient degree of intelligence to appreciate the value of his teeth and of our work, no difficulty will be encountered.

It is suggested to the patient that there should be only two places where the denture ought to be: either in the mouth or in a glass of cold water. The reasons for this will be obvious to any one. We see to it that the patient obtains a proper clasp brush to clean the inside of the clasps and instruct him to brush the denture frequently with warm water and soap to dissolve the grease film which might otherwise develop.

It is well to show the patient by means of a mirror and mouth lamp the exact fit of the bridge and the perfect restoration of his missing teeth and soft issues, so that he has a vivid and favorable impression of the work at the time of placing. It is especially valuable to have the patient give a voluntary expression of his satisfaction at this time, in order to place him on record. He may be reminded of this in the event he has a subsequent change of heart. The patient can now be dismissed with instructions to return in a few days unless severe pain or discomfort would make this imperative sooner.

ADJUSTMENTS

If the foregoing seems tedious to the casual observer, he may reflect that, to the extent that we have taken proper steps and pains to fit the case perfectly, and make the patient comfortable, to that extent have we reduced, as far as is humanly possible, the need for frequent and lengthy adjustments, which are the bugbear of all dentists. Nevertheless, adjustments are necessary, as a rule, even though we may have done our best to keep them down to a minimum.

The patient usually returns with a complaint that there is some pain or that the case is too loose or too tight. Of course, we first relieve the pain. This may be present in the teeth or the soft tissues. We have to locate the source and verify the patient's complaint. Frequently, we are led astray through the patient's inability to observe correctly what he feels; hence, a careful checkup is needed. Usually, the cause is too much pressure from the clasps on the abutments in certain directions. We test the abutments by percussion and pressing. The direction in which the pain becomes worse is the one in which too much pressure is being exerted, and this must be relieved. After a careful examination, which sometimes requires all our skill, we may find small shiny facets on the insides of the guilty clasps and remove them with small stones. We study both sides of the occlusal lugs and remove any shiny spots that may be present. We trim the gingival margins of the saddles wherever there is evidence that they press too hard, and, at all times, leave the margins nicely rounded and repolish all places which we have freshly ground. A perfect polish will do much to make the denture comfortable. In this respect, it might be well to state that no denture can be considered well polished if any

scratches are visible on any surface, and that rough or sharp spots may cause chronic irritation leading to malignant tumors.

We relieve the occlusion where this may be needed and study and make a mental record of the accuracy of the patient's observations and perceptions as compared with that at the time of placing. We correct the looseness or tightness of the denture, being guided by the patient's experience during the interval in which he has worn the bridge, and we see to it that we stay well within the area of leeway in adjusting the clasps in either direction, as was described before.

We watch for unopposed forces which might have been overlooked heretofore. These can quickly play havoc with our work and the patient's mouth, and we overcome this condition as much as possible through a process of elimination or compensation. In short, we have, in this first adjustment, a fine opportunity to correct the defects of our work and a chance to reflect that a little more time spent in fitting and placing would probably have saved the patient a great deal of discomfort and pain, and quite a little time and work for us.

We notice the condition of cleanliness and study the patient's psychologic attitude toward his restoration, after he has had a chance to wear it, and we repeat or emphasize our instructions to him as conditions may demand. Finally, we make sure that his complaints are entirely relieved and nothing is left undone to make the patient comfortable as far as that is possible. Before he leaves, we again lead the patient to admit that the case feels in perfect condition.

Two or more adjustments may be required to make the patient entirely comfortable. A careful checkup and comparison should be made of the extent to which the previous complaints have been eliminated or new ones developed. All these complaints should be entirely relieved before the patient is dismissed each time. We must bear in mind that if the denture is properly constructed, it should require but little adjusting and that many adjustments usually indicate a severe defect or a misfit.

In this respect, it is not amiss to point out that, as a rule, we can take the patient's word for granted even though he may express himself faultily or inaccurately. It has been the general experience that, with few exceptions, no patient will continue to complain and find fault with the case unless there is a good reason for it, even though the reason is not apparent to the dentist, and that the reverse, which means silence in the presence of justified complaints, is far oftener the case.

For that reason, I wish to admonish all those who undertake to construct cast partial dentures to be tolerant and patient, and to take enough time to relieve completely all complaints of their patients. A removable case can so be made that no discomfort remains, and the patient has a complete restoration of masticating functions, together with reasonable esthetics, without undue interference with lips, cheeks or tongue.

Patients are entitled to this, and are led to believe that they will receive it, and nothing short of physical limitations should bar a dentist from delivering this service. It is my sincere conviction that aside from poorly designed or selected cases, no other condition has contributed more to producing failures and a lack of confidence in removable prostheses among patients, as well as dentists, than neglect to give heed to all reasonable complaints.

Nothing is more disheartening to a patient than to be told that even though the denture may hurt him persistently, he will get used to it sooner or later, notwithstanding the fact that, on examination, it can readily be seen that the denture is binding between the abutments, the occlusion is too high or the clasps are moving the teeth. All such conditions can and should be corrected, and the fact that the case is laboratory-made and the dentist cannot readily locate the cause of the trouble is no excuse whatsoever. If we are not to lose the respect and confidence of our patients, more thoroughness and application in considering their complaints will have to be practiced, as all those who specialize in this branch of dentistry well know. Let us be square with our patients and ourselves, and at all times give the patient the benefit of the doubt.

MAINTENANCE

We now come to the most neglected phase of partial denture construction: maintenance. There probably are good reasons for this, for besides the lack of recognition on the part of the dentist, we also have to contend with the negligence of the patient, which is only too often the sole cause.

We should start out, of course, to instruct patients to return at six month intervals, at least, so that we can examine the case at the time of the regular prophylactic treatment. Uniformly, patients will agree to this and promise to return, but although they are reminded regularly, experience shows that by no means all return when due. There are several reasons for this, such as absence from the city, sickness, and preoccupation, but the principal one is that to which all human flesh is heir, inertia. We can hardly blame the patient though and probably would do the same or worse if similarly situated. The bridge has been carefully fitted and adjusted and is functioning perfectly, and the patient cannot see why he should have to put himself out and be bothered again by his dentist only to be told that the case is all right, which he already knew, or to find some other trouble, of which he is not in the least anxious to learn. Consequently, the dentist frequently starts out with a handicap through lack of cooperation of the patient, which is difficult to overcome.

Nevertheless, his duty to his patient demands that, at all times, he should be anxious to ascertain whether the denture is functioning properly and should continue his efforts to have the patient come in at regular intervals. This does not mean that he should have to assume any responsibility for trouble arising from the negligence or carelessness of the patient or accidents occurring to the bridge. On the contrary, it should be understood that his duties do not include such extraneous services, but a check-up and correction of any defects in performance, together with repairs owing to faulty materials or workmanship, are due the patient for a reasonable length of time.

Of course, in the vast majority of cases, no such troubles arise, and we can keep our work in good shape with small effort. It is remarkable how little will go wrong, even over a period of many years, when the denture has been properly designed and constructed, and the occlusion perfectly balanced. Need for rebasing, which is so frequently heard of, is seldom present under those circumstances. It is the general experience that resorption will be slight and gradual, if even distribution of masticating force throughout the whole mouth has been provided for, and severe and quick resorption can usually be attributed to faulty and unbalanced occlusion. For that reason, we

must check the occlusion at regular intervals and make corrections whenever needed. We are very prone to neglect to do this because we naturally take our work for granted after it once has been properly done and completed. Notwithstanding this, we find frequent changes taking place, largely due to the uneven wear that occurs when gold and porcelain are biting against the same surface or against each other.

When large restorations are made and the entire mouth is reconstructed, we often have inlays and porcelain jackets, as well as a large removable bridge with porcelain occluding surfaces in both jaws. Because of the difference in relative hardness, the inlays will wear considerably faster than the porcelain, regardless of the quality of gold used. This may explain some of the sudden fractures of porcelain jackets that occur now and then, as well as the sometimes severe changes in the soft tissues under removable work. This is the most difficult condition that we have to deal with, and I am at a loss to suggest a remedy for it, as I know of no method by which the physical properties of gold and porcelain can be altered or influenced. The possibilities of the success of our work are directly limited in proportion to the presence of this condition, and it looks as if there is little that we can do about it.

The results of these changes in occlusion and consequent masticating pressure are varied. We may find more or less resorption and will have to correct that through rebasing, if necessary. Flabbiness as well as hyperemia of the gum tissue may occur and will have to be corrected accordingly, by removal of the source of extra pressure, whatever this may be. Some very puzzling conditions may occur in this respect, conditions that baffle the most experienced operator and tax his ingenuity. Good judgment and careful inquiry, through a process of elimination, will usually lead to the real cause, which can then be corrected as far as possible. Habits such as gritting the teeth while sleeping, chewing mostly on one side and protruding the lower jaw in a sliding motion are frequently to blame for the trouble.

It is in cases such as these that goodwill and forbearance on both sides will be badly needed. It is from those cases that we learn to be patient at all times and not to promise too much. Patients wearing one or two large restorations are dental cripples in the true sense of the word. Our work can restore to them their proper dental functions and esthetics to a degree far exceeding that of any other form of human prosthesis. If the patient doubts this, we only have to ask him how much he can see with a glass eye in order to have him better appreciate our efforts. These large restorations are the best that can be made by human hands, but they are by no means perfect.

Patients and dentists should always bear this in mind, and the latter should avoid raising undue hopes or making promises that cannot be kept. At the best, there is a distinct physical limit to our ability to save teeth. As the patient grows older, so do his teeth, together with his partial denture, and no one has yet been able to prolong the life of human teeth indefinitely. A proper realization of these facts is not obtained by any one until after long experience, and all of us, either as dentists or patients, will have to learn this sooner or later.

This will permit us to feel that our efforts were not in vain, and that the results of our work have justified the time and skill put into it, even though we know that it probably will not last as long as the patient may live. If thought

and attention is given to correct diagnosis, design and construction, the time and ability applied to the details of fitting, placing and maintenance of the cast partial dentures will, with but few exceptions, eliminate the failures that have occurred in the past.

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CAVITY PREPARATION WITH SPECIAL REFERENCE TO PULP PROTECTION, FOR VARIOUS FILLING MATERIALS*

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IN this paper, dealing with cavity preparation, I shall not attempt to give the operative procedure in detail, as that is a phase of dentistry which in itself could be the subject of a very long paper. Instead, I shall deal with general principles of cavity preparation, and discuss certain aspects which, though less commonly considered in the writing of dental papers, have an important bearing on the subject, directly or indirectly.

It is obvious that any one attempting cavity preparation should have a knowledge of the anatomy of the pulp, if he has for his objective the preservation of that delicate, vascular tissue. It seems appropriate, therefore, to begin this paper with a brief description of the pulp, macroscopic and microscopic. As a general rule, the shape of the pulp of a tooth conforms roughly to the shape of the crown of the tooth, but there are enough minor differences to warrant a brief description of the pulps of the individual teeth. In this description, I shall take as my guide Black's Dental Anatomy.

*Read by William Edgar Coleman, Atlanta, Ga., in the absence of the author.

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PULPS OF THE UPPER INCISORS

In the incisors, there is no sharp differentiation in the pulp of the coronal portion and that of the root portion. The pulp is broadest mesiodistally, and tapers gently as the root portion is approached. The pulp chambers of the central and lateral incisors are so similar that a description of one will do for both. The largest diameter of the pulp cavity occurs about the level of the gingival line on the labial surface. Black says that in young incisors just erupting, he has found the diameter of the pulp at the gingival line to be from one-fourth to one-third the diameter of the neck of the tooth. He says further that, in early adult age, the pulp may average about one-fourth the diameter of the neck of the tooth, with a range, with approaching age, to one-fifth, one-sixth or, in the extreme, to one-tenth. The chambers and canals in the lateral incisors are, of course, a little smaller than those of the central incisors, but they are proportionately larger when the size of the tooth is considered. This fact accounts for the frequent exposure of pulps in the lateral incisors during cavity preparation. In very young teeth, three short horns are often present, cor-

responding to the position of the mamelons.

PULP OF THE UPPER CUSPID

There is not a great deal of difference in the general shape of the pulp of the upper cuspid and that of the upper incisors. The coronal extremity of the pulp of the cuspid has a central horn which is not present in the incisors. This horn extends toward the cusp of the tooth, the mesial and lateral horns being practically obliterated. The pulp chamber extends toward the cutting edge of the tooth about two-thirds the length of the crown. The pulp is proportionately smaller than that of the incisors, and its greatest diameter is at the gingival line, from labial to lingual. The proportionately smaller size of the pulp of this tooth and the tapering of the coronal portion of the pulp accounts for the extensive cavity preparation that can be done on a cuspid tooth without injury to the pulp.

PULP CHAMBER OF THE LOWER CUSPID

At the neck of the tooth, the labial portion of the pulp is wider than the lingual, and the long diameter of the pulp is from labial to lingual aspect. The coronal portion traverses about two-thirds the length of the crown toward the point of the cusp, where it ends in a point, or horn, which is usually very slender. Here again, proportionately extensive preparation may be done without encroaching on the pulp.

PULP CHAMBERS OF THE LOWER INCISORS

At the level of the gingival line, the long diameter of the pulp is from labial to lingual aspect. As the coronal extremity of the pulp is approached, the diameter gradually diminishes labially-lingually, increases mesially-distally and ends in a thin edge. The pulp chamber extends toward the cutting edge about two-thirds the length of the crown. Cavity preparation in these teeth is most delicate.

PULP CHAMBER OF THE UPPER FIRST BICUSPID

In this tooth, there is a sharp differentiation between the pulp of the crown and that of the root portion, which is not the case with the incisors and the cuspids. The pulp chamber of this tooth is centrally placed in the long axis of the crown. The axial walls are about equal in thickness, but the occlusal walls are thicker than the axial, their thickness varying from one-third to two-thirds the length of the crown. Toward the apex of each cusp, a horn extends. The height and the sharpness of the cusps determine the height and sharpness of the horns of the pulp. In teeth with very high and well-pronounced cusps, such as we often see in newly erupted bicuspids, there are often very long and slender horns. Black has reported that, in some bicuspids with very pronounced cusps, this horn has extended almost to the enamel. Of course, these horns become shorter as age advances. Here, eternal vigilance must be exercised to avoid the area of the recessional lines of the horns, which are the lines along which the pulp recedes as the age of the tooth advances, and at times there may be a tract containing a filament of the pulp tissue, the striking of which gives us the equivalent of an exposure.

PULP CHAMBER OF THE UPPER SECOND BICUSPID

There is little difference between the shape of the pulp of this tooth and that of the upper first bicuspid. The horns of the pulp of this tooth are usually shorter, and the recessional lines are not so pronounced nor so likely to inject them-

selves into the preparation of the cavity, as in the first bicuspid.

PULP CHAMBERS OF THE LOWER BICUSPIDS

The pulp chamber of the lower first bicuspid ends in a horn extending toward the point of the buccal cusp. There is no definite horn extending toward the lingual cusp, although a protrusion of the pulp in that direction is discernible. These teeth seldom show a definite line of demarcation between the coronal pulp and that of the root canals.

In the lower second bicuspid, the pulp extends into a lingual horn as well as into a buccal horn, and the lingual horn may sometimes be very slender, especially in young teeth. In the lower bicuspids having three cusps, two horns of the pulp extend on the lingual side, spreading toward the mesial and distal aspects. Though the horns themselves are usually short, their protrusion brings them nearer the surface of the tooth than other horns of the pulp. This accounts for the greater likelihood of opening into that portion of the pulp in excavating proximal cavities.

PULP CHAMBERS OF THE UPPER MOLARS

The pulp chambers and the root canals of these teeth are sharply differentiated, the root canals being minute openings into the pulp chamber. The average diameter of the pulp chamber of this tooth is about equal to the thickness of the axial wall by which it is surrounded. The occlusal walls are usually considerably thicker than the axial. The pulp chamber corresponds in form to the crown of the tooth with horns of the pulp extending toward each cusp. These horns are usually very pronounced in young teeth, and, of course, wear down or recede with advancing age. The thickness of the walls of this tooth accounts for the rather extensive cavity preparation which can be made on the tooth; hence, the tooth serves well as an abutment for bridges in the form of crowns and inlays.

PULP CHAMBERS OF THE LOWER MOLARS

The pulp chambers of these teeth, though they correspond to the general shape of the crowns, as is the case with the other molars, are somewhat more angular. The occlusal wall of the pulp chamber shows a convexity toward the pulp. From the extreme angles of the pulp, the horns extend toward each cusp. The diameter of the pulp chamber of this tooth varies greatly according to the age of the individual. In youth, it may be as much as two-fifths the diameter of the crown, and it is seldom less than one-third. The diameter of the pulp decreases greatly in old age, owing to the deposit of secondary dentin, a result of abrasion, and the pulp chamber in old individuals may often be almost obliterated. Here, then, the age of the patient is an important factor in determining the extent of cavity preparation.

GROSS ANATOMY

A thorough knowledge of the gross anatomy of the pulp will enable the operator to avoid exposing pulps needlessly. Likewise, a thorough knowledge of the histologic or microscopic structure of the pulp will aid him in applying his knowledge of materia medica in the treatment of diseased pulps.

The tooth pulp is an embryonic connective tissue consisting of fine reticular tissue and a mucoid matrix containing comparatively few cells. This tissue, or "nerve," as it is commonly called by the laity, is exceedingly vascular, containing

numerous capillaries which terminate in a plexus immediately beneath the odontoblasts lining the periphery of the pulp on all sides. The nerves of the pulp have the same general distribution as the blood vessels, and end in a plexus of filaments just beneath the odontoblasts. The nerve fibers are medullated in the body of the pulp, but lose their medullary sheaths as the periphery of the pulp is approached. The fact that the walls of the capillaries are exceedingly thin and their lumens large, and the further fact that the pulp is so richly supplied with nerves, accounts for the extreme sensitivity of the pulp to bacterial infection and to irritants. The lining cells, or the odontoblasts, are responsible for the deposit of secondary dentin when such unfavorable conditions as abrasion and bacterial infection through caries are encountered.

Dentists are too prone to condemn a pulp when it manifests symptoms of disease or irritation. One would not think of enucleating the eye simply because of an iritis or a conjunctivitis. The efforts of the physician would be directed first toward relieving the condition by remedial measures. Though the pulp has probably less resistance than the eye to infection, it nevertheless possesses the power of recuperation when the cause of the disturbance is removed. While it is true that pulpectomy is the only relief for very badly diseased pulps, it does not follow that extirpation of the pulp is necessary in all cases of diseased or irritated pulps. Indeed, the pulp of any tooth harboring caries in the dentin must become infected, at least in a degree, as it is a well known fact that the micro-organisms of caries penetrate and extend through the organic matter of the dentinal tubules with apparent ease.

Unlike most of the other tissues of the body, the pulp is enclosed within an unyielding wall. When hyperemia of the pulp occurs, the tissue has no room in which to expand; hence, the clinical symptoms are definite and sharp, and sometimes result in an exaggeration of the seriousness of the trouble in the dentist's mind. Insufficient consideration is given the pulp in cavity preparation and in the treatment of that organ.

If one is to prepare cavities properly, he should know more than the gross anatomy and the histology of the pulp. A knowledge of the histology of the enamel and dentin is of utmost importance. I shall not take the time in this paper to attempt an exhaustive histologic description of the enamel and dentin, as that would be without the scope of this treatise. Suffice it to recall to your minds that the enamel consists of enamel prisms or rods. The direction of these rods is usually at right angles to the surface of the tooth in which they are found. The rods are held together by a cement substance which is softer than the rods themselves; therefore, we have that characteristic of enamel known as cleavage. There is comparatively little organic matter in the enamel. The various calcium salts constitute the bulk of the enamel substance, and are present in the following proportions (other constituents are also given): calcium phosphate and fluorid, 89.82 per cent; calcium carbonate, 4.37; magnesium phosphate, 1.34; other salts, 0.88.

The rest of the enamel substance, which is organic matter, is present in the percentage of only 3.59. Though the dentin contains practically the same chemical constituents as the enamel, it contains organic matter in the percentage of 27.61, which is approximately nine times the amount found in the enamel. It is well

known that bacteria attack organic matter much more rapidly than inorganic; hence, it is easy to understand why caries penetrates the dentin more rapidly than the enamel. The dentinal tubules contain organic matter principally in the form of fine nerve filaments from the odontoblasts around the periphery of the pulp. This organic matter is readily attacked by the organisms of caries, and a rapid invasion takes place in the direction of the pulp. Once the dentin is reached, the decay also spreads laterally along the dentino-enamel junction, owing to the presence of the granular layer of Tomes in that location and to the increased amount of organic matter. It therefore follows that caries involving the enamel only does not require removal of so much tooth structure as that involving both the enamel and the dentin, and that it is manifestly more logical to fill the tooth when the carious area is small than to wait until the dentin is invaded.

TREATMENT OF FISSURES

One of the surest ways to conserve the pulps in teeth is by filling those teeth before decay becomes extensive, or, better still, by filling them before caries even begins. In his "Letter of Explanation About Fissures" Thaddeus P. Hyatt, dental director of the Metropolitan Life Insurance Company, states that "there are 2,500 chances to one that a fissure will decay in less than twenty years." He says further: "Professor C. F. Bödecker also has shown in his article in the *Dental Items of Interest* for November, 1926, that 2,400,000,000 bacteria can find lodgment in the average-sized fissure. I leave it to you to decide on the *morality* of exposing any child to such odds. I also leave to you the decision if an occlusal pin-hole filling is as dangerous to the tooth as is an open and unfilled occlusal fissure." Dr. Hyatt also states that "in the examination of over 50,000 cases, we find that here in our country, and in our present state of civilization, less than one-twentieth of one per cent are immune to caries; also, that these persons who are immune have teeth that are practically free from pits or fissures." And Dr. Hyatt very aptly adds: "Please make your own deductions."

Unfortunately, the public has not yet been convinced of the importance of filling fissures in newly erupted teeth, and most dentists must still be confronted with the necessity of filling teeth after caries has become extensive. With reference to the manner in which caries occurs, there are two great groups of cavities, namely, pit and fissure cavities, and smooth surface cavities. The former are found wherever pits and fissures occur, and the latter, as the name indicates, are found on portions of the surfaces of teeth which do not present pits and fissures for the beginning of the process of caries. This process, as far as the dentin is concerned, is identical in both of these groups, but the processes in the enamel are quite different and require different treatment in cavity preparation with reference to extension for prevention.

Pit and fissure cavities begin in pits, grooves or fissures. Here, they cover themselves with a gelatinoid substance, which makes their hiding place secure, so to speak. Their nest or nidus is thus formed, and they grow and multiply. Their acid products dissolve out the lime salts which hold the enamel rods together, and thus form a channel for the progress of the micro-organisms toward the dentin and induce a general undermining of the enamel beneath the surface. This undermining along the dentino-enamel junction is sometimes termed "backward decay." The only evidence, on the surface, of such

a process, may be a darkened line in the groove, or a spot in the pit, pressure on which with a cutting instrument may cause the surface to cave in. The process, on reaching the dentino-enamel junction, finds less resistance here than in the enamel, and the spread is more rapid. Because of the inclination of the enamel rods toward a groove or pit, we have the cone-shaped area of decay in the enamel here, with its apex toward the surface and its base toward the dentino-enamel junction. The cone of decay is larger in the dentin than in the enamel because the dentin is more vulnerable. The cone of decay in the dentin always has its base at the dentino-enamel junction, and its apex toward the pulp.

In the preparation of cavities of the pit and fissure group, it is necessary only to remove the enamel covering the area undermined by caries and form the cavity in the dentin. Further extension for prevention of recurrence of caries is not necessary, except where it may be required to follow out deep grooves to places where a smooth margin may be given the filling, or restoration.

Smooth surface cavities have their beginnings in surfaces which are free from structural defects. Micro-organisms must, therefore, attach themselves to the surfaces in areas which are more or less hidden from the excursions of the food and saliva, as in the proximal surfaces and in the habitually unclean areas, left so by inadequate use of the toothbrush, as at the gingival margin of the buccal and labial surfaces.

Here, again, the micro-organisms collect and cover themselves with a gelatinoid substance, their acid products dissolving out the lime salts of the enamel; but because of the difference in the inclination of the enamel rods here as compared to those surrounding a groove, the caries spreads laterally on the surface, each part of the widened area of beginning caries penetrating the line of the length of the enamel rods. This gives a conical area of caries, with the base of the cone at the surface and the apex toward the pulp.

This is just the reverse of the process having its inception in the enamel surrounding a groove, fissure or pit, while the decay in the dentin is identical; or, to repeat, immediately the enamel is penetrated, caries spreads laterally along the dentino-enamel junction in every direction.

The extension of the margins of gingival third cavities from the center of the surface far toward the mesial and distal angles of the tooth is so necessary that the rule should be to cut them close to the angles in every case, but never past the angles. Herein alone lies safety; for if this is not done, and susceptibility to caries continues, caries is almost certain to recur at the mesial or distal aspect, or at both, the filling being lost, and the pulp further disturbed by the preparation of a more extended cavity. Why to the angles? Because these are areas of natural immunity. I might mention that, in a record of 10,000 cases examined in the dental clinic of Northwestern University, Chicago, only nine presented caries beginning at these angles of the tooth; and, in all of these, there was some natural or acquired fault of occlusion, i. e., teeth twisted, not occluding, lost or abscessed, normal use being thereby prevented.

In laying the gingival wall of a cavity, we should be guided by the age of the patient. If such cavities are filled in young persons without pushing the gingivae well back so that the margin of the cavity can be extended well under the gingivae, as age advances an exposure of

the enamel between the gingivae and the filling will result. Such an exposure may result in further caries, necessitating further cavity preparation and attendant needless irritation of the pulp, all of which could have been prevented by making the first preparation extensive enough. Tooth structure is *not* saved by inadequate cavity preparation, nor is the pulp preserved.

I shall now take up briefly the preparation of cavities in the various teeth, and mention a few general principles bearing on the relation of proper cavity preparation to pulp conservation.

INCISORS AND CUSPIDS

In a horizontal section through an incisor or cuspid, the enamel rods are cut parallel with their length in all their parts, but they do not all stand at right angles to the surface of the tooth. The deviation is greatest as the angles are reached in passing from the proximal to the lingual surfaces. This, interpreted in its application to cavity preparation, means that it is not safe to lay cavity margins at these angles, as the rods will most likely be left unsupported. If the decay reaches these margins, the margins of the cavity must be carried over to the lingual surface.

In the preparation of proximal cavities for foil in the incisors and cuspids, care should be taken in placing convenience points. These should not be cut into the gingival wall, but into the labial and lingual walls. The reason for this is obvious when one considers the closer proximity of the pulp in the gingival portion of the cavity. Large convenience points in cavities are unnecessary. These points, when filled, convey thermal changes to the pulp in the same manner that the general body of the restoration would. There is also frequent danger of running into the horns of the pulp with large convenience points.

In the upper incisors, particularly the lateral, there is very often a pit in the cingulum which extends to quite a depth. It is not good procedure to carry the floor of the cavity to the depth of this pit of decay. This is obviated by following out the area of decay with a small round bur, and, when this operation is completed, filling this channel with cement.

It is also well to remember that, in proximal cavities in the incisors and cuspids, where caries has undermined portions of the labial and lingual surfaces, the carious process in the dentin in the central portion of the cavity is often checked. In such cavities, it is necessary to cut around the pulp to the labial and lingual aspect. This will give a rounded pulpal floor to the cavity, and will avoid the exposure of the pulp which would result if the pulpal floor in such cavities were made flat.

BICUSPID TEETH

Recalling the gross anatomy of the pulp of the bicuspid tooth, we will remember that the horns of the pulp, particularly in the upper bicuspids, and in the lower second bicuspid, are prominent and slender, and that recessional lines of the horns of the pulp often extend toward the cusps for a considerable distance. The location of these should be carefully studied and avoided, if possible, in cavity preparation in these teeth. It is here that unintentional exposure of the pulp often occurs, for the reason that, in the process of the development and recession of the pulp, this tract is not always completely closed, and a slender thread of pulp tissue will often persist in the tract. Of course, even the most minute portion of an exposed pulp is sufficient for the beginning of an infectious process when such part

is brought in contact with the micro-organisms of the mouth.

A point to be remembered in the preparation of occlusal cavities in the bicuspids, particularly the upper bicuspids, is that such cavities call for a very shallow preparation in the central line of the groove, because of the very deep inclined planes from the cusps. When the cavity is widened buccally-lingually, the line angles of the floor may strike the horns of the pulp.

MOLAR TEETH

In very deep occlusal cavities, it is not necessary to carry the floor of the cavity to the depth of the decay. The caries in the center of the floor may be removed, and this cupped-out area filled with cement. Exposures often result from the operator's attempting to flatten out the floor of the cavity to correspond to the depth of the small area of caries in the central portion of the cavity, thereby invading the area of the horns or the recessional lines of the pulp.

In mesial cavities of upper molars, the occlusal step may be made broader than it could be in distal cavities of the upper molars or in mesial and distal cavities of the lower molars, because the lingual horn of the pulp in the upper molars is situated farther distally. This affords more room in the neighborhood of the mesial surface.

Black says, "In the preparation of proximo-occlusal cavities there is usually room to occupy one-third of the bucco-lingual breadth of the tooth in a step without interfering with the pulpal horns, provided the step is not cut too deep, i. e., deeper than necessary for substantial strength."

It must be remembered in the preparation of cavities in molar teeth that the pulpal horns in the mesial portion are longer, and that there is more danger of cutting into the recessional lines in the mesial portion than in the distal.

I should like to recall to your minds a few points of a general nature which, simple though they are, are often overlooked by dentists in the course of cavity preparation.

Metal fillings cannot be placed so near the pulp as can porcelain inlays, for the reason that metal conducts thermal conditions more readily to the pulp. For the same reason, an inlay may be placed nearer the pulp than a gold foil filling may. Though the layer of cement between the inlay and the floor of the cavity may be exceedingly thin, it is nevertheless sufficient to interrupt the transmission of changing thermal conditions to the pulp. But it must also be borne in mind that cement itself is irritating to the pulp. A cavity for a porcelain inlay may be made so deep that the irritation of the cement may counterbalance the harm resulting from a metal filling of the same depth.

Generally speaking, the use of procain is a dangerous thing in cavity preparation. In eliminating pain, it does away with the signals which warn the operator of the close proximity of the pulp. There are times when its use is indicated, but the occasions are rare. The dentist seeking to relieve the patient of pain incident to cavity preparation should employ other methods. The use of tepid water during cavity preparation, the use of sharp burs and a more extended use of the cutting instruments will accomplish much in that direction. The use of sharp burs in the preparation of cavities keeps down unnecessary friction, thus preventing thermal shock and consequent pain. The water also keeps down friction. If it is tepid, its temperature will not act as a pulp irritant.

One of the redeeming features of the inlay is that it does away with the need for the deep portions of cavities, often made necessary by the use of other filling materials, for the sake of retention.

DISEASED OR EXPOSED PULPS

Lastly, we come to the treatment of diseased or exposed pulps. When a dentist speaks of preventing caries, he usually has in mind the prevention of external or apparent caries. Too little attention is given to the caries in the floor of the cavity. Most of the micro-organisms of the mouth are facultative, and can thrive with or without the presence of free oxygen. If it is impossible to remove all the carious dentin without exposing the pulp, it is very necessary that the remaining dentin be treated in a manner that will inhibit the progress of further caries. This is done best by sterilizing the remaining dentin and at the same time placing some agent in the cavity which will allay the irritation and soothe the pulp. While it is true that in most cases where caries extends to the pulp the removal of that organ is necessitated, there is a possibility of preserving the pulp in some instances, particularly in the teeth of young individuals. Even the small percentage of cases which would respond to pulp treatment should warrant our efforts along the line of pulp preservation.

What treatment should be given the pulp when the removal of all caries is not possible without exposing or endangering it? Various methods have been successfully used by dentists in the past, a few of which I shall outline.

Silver nitrate may be used extensively in the treatment of remaining carious dentin. When applied to the dentin, it forms a hard coagulum which resists caries. Care and precaution should be exercised in its use, and a rubber dam should be placed over the tooth wherever it is possible to do so. The silver nitrate is placed on the carious dentin with a pledget of cotton. It may be precipitated with oil of cloves, and should not be placed by itself in very deep cavities. Over this may be placed a eugenol-cement base; that is, a thin mix of "silver B" cement, with eugenol as the liquid instead of the regular liquid furnished by the manufacturer. Over this pulp-capping, the regular cement base may be placed. The tooth should be left alone for a week or more, for purposes of observation. If, at the end of that time, it gives no further symptoms of pulp irritation, a regular, permanent filling may then be placed.

Some dentists have found the use of black copper cement effective in the treatment of pulps. The black oxid of copper content in this cement is about 90 per cent. Copper salts are known to have an inhibitory effect on caries. The principal objection to this kind of cement is the discoloration to the tooth which follows its use. There are also various proprietary preparations on the market, some of which possess decided virtues.

Perhaps the tooth most commonly the seat of caries and pulp trouble is the first permanent molar. Early caries in this tooth is a serious matter, for, if the pulp is involved, the dentist is confronted with the question as to whether to attempt to save the pulp or to remove it. It is practically impossible to place a good root canal filling in this tooth before the ninth year, at which time the apex has usually attained its final form. On the other hand, the chance of saving the pulp through treatment is comparatively small. The dentist must take many things into consideration before he makes his final decision. The ideal thing is to obviate the necessity for such a situation arising. As I mentioned earlier in this paper, it is

much better to fill undecayed pits and fissures in these teeth than to pursue the policy of watchful waiting. There are various ways that these undecayed pits and fissures may be treated. Aside from actual cavity preparation involving these pits and fissures (which would seem more logical), a method which has found favor with some is as follows: 1. Remove débris with a stiff brush and a needle-pointed explorer. 2. Dry out with alcohol. 3. Apply silver nitrate for three minutes. 4. Precipitate with solution of formaldehyd, U.S.P., if quick precipitation is desired. 5. Wipe out with a pledget of cotton. 6. Apply good cement. (Place the cement at the marginal ridges of the tooth, and work it down into the pits and fissures with an explorer.) 7. With fingers coated with cocoa butter, apply pressure to the cement.

During the entire procedure, the tooth should, of course, be kept perfectly dry with a rubber dam.

It is my observation that dentists in the past have given entirely too little attention to the treatment and conservation of the pulp. The pulp of a tooth is worth saving, and, in cavity preparation, as well as in the specific treatment of the pulp, its value as a vital tissue should be realized by the dentist. I have endeavored here to stress a few principles which, when applied either directly, as in the case of pulp treatment, or indirectly, as in the case of cavity preparation, will result in a further conservation of the pulp.

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THE WRITINGS AND ACTIVITIES OF DR. ALFRED OWRE IN RELATION TO THE STATUS OF DENTISTRY: A CRITICAL ANALYSIS

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THE very foundations of the American republic were built upon tolerance and the right of the individual to form, hold and express his opinions on any and all subjects. That privilege is recognized today. There is a marked distinction, however, between toleration of an opinion and toleration of an effort to enforce that opinion and bring about an undesired end. For example, one could tolerate the view that the United States should again become a colony of Great Britain, but one could not justly be termed intolerant if he believed such a step to be undesirable and opposed every effort to bring about such a condition.

The foregoing statement of principle is presented as preliminary to this analytic study of the writings and activities of Dr. Alfred Owre in relation to the status of dentistry, so that the reader may understand that there is no question about the right of Dr. Owre the individual to form and express any opinion. It is believed, however, that the opinions of Dr. Owre, expressed officially as dean of the School of Dental and Oral Surgery of Columbia University, and any efforts to enforce those opinions on an

unwilling majority, may be vigorously resisted without subjecting the resisters to a charge of intolerance.

From 1921 until 1926, the Carnegie Foundation conducted a survey that included an intimate study of all phases of dental education, and a serious consideration of the various theories advanced regarding the status of dentistry and its relation to health service. Conferences were held with the most prominent dental and medical educators and with the presidents of most of the universities having dental and medical schools. It is a fact that more than 300 of these advisers read the following statement in a preliminary report of the study without raising any question as to its fundamental logic and soundness:

> Dentistry can be effectually and economically developed to the full service equivalence of an oral specialty of the practice of medicine through extension and improvement, in universities, of that system of dental education which, though separate from medical education, is closely related to it and should be more intimately associated with medical schools, hospitals and dispensaries.

For a number of years, Dr. Owre has shown in his writings a smouldering desire to see dentistry disintegrate into several parts; some to be included in the practice of medicine, and the rest to be "relegated" to "technicians."

Among his most pertinent paragraphs bearing on this question are the following:

> Assuming that there will be no dissent from my thesis that our ultimate status is that of *a specialty in medicine*[1] our present problem becomes that of arranging, insofar as possible, a pre-medical year. . . .
>
> When the opportunity comes for adding a second pre-dental year (*by that time it may be termed pre-medical*[1]), it is to be hoped that certain changes will have been made by medical educators so that we may list mathematics and foreign languages as prerequisite electives to balance shop practice and technical drawing. Such a program would accomplish our ideal of providing for the development of two necessary types of specialists; those who realize their ideals largely thru the fingers, and those who find themselves thru abstract study. . . .
>
> This gives unqualified support to the thesis that as dentistry becomes perfected scientifically, *its former independence must disappear.*[1] So much for the necessity for extending the course in dentistry—a necessity, I am optimistic enough to assume, will be universally conceded.[2]
>
> Perhaps this establishes the thesis that if dentistry makes good its claim as a profession, *its former independence must disappear.*[1] It may justify, also, the recent requirement among university dental schools, of a five-year curriculum—two years of which are largely identical with the medical course. It may even justify the hope of university educators that in time there can be worked out a joint curriculum without lengthening the course beyond the present limits of the medical course, possibly even shortening that—which will entitle a dentist to rank as an oral specialist in the greater field of medicine.[3]
>
> Now let me come down to brass tacks. *I have made an hour analysis of the present medical curriculum with a view to incorporating dentistry in a reorganized and shortened course.*"[1] (President's address at the annual meeting of the Dental Faculties' Association of American Universities, Jan. 19-22, 1923.)

In 1926, however, the Association of American Universities' Committee on Dental Education, of which Dr. Owre was a member, presented a *unanimous* report which included the following:

> It is realized widely among dentists that equivalence in health service with an oral specialty of medical practice can be achieved by dentistry without embarrassing the present organization of the medical schools if dentistry, *maintaining its professional independence and continuing its own schools,*

1. Italics not in original.

2. The Necessity for, and the Scope of the Pre-Dental Year, Proc. Twenty-Seventh Annual Meeting American Institute of Dental Teachers, January, 1920.

3. A View of Dental Education, Minneapolis Dist. Dent. J., September, 1922.

adapts its system of education and its practice to the attainment of this purpose.

Dr. Owre's approval of this report in 1926 indicates either that he endorsed its context, or that he wished others to *think* that he had.

Except for the retirement of its chairman, Dr. Gies, so that the other members of the Committee would be completely free and unembarrassed in discussing the findings of the Carnegie Foundation's Study of Dental Education, as published in Bulletin No. 19 in 1927, the same committee was continued until 1928, when Dr. Owre, then the chairman, brought in a *"committee report"* which contained the following statement:

Your committee[1] believes that the only hope for dentistry lies in its restoration to its former status of a specialty in medicine, with the ultimate *incorporation of existing schools of dentistry into the better medical schools. The moment for this is actually arriving.*[1]

The proceedings of the Association of American Universities, when published, did not indicate that the report presented by Dr. Owre was not submitted by the committee, but in 1930, *two years later,* Dr. Owre acknowledged publicly the fact that *he* had written the foregoing report and had *personally* submitted it as a *committee report* without the approval of his committee. In professional circles, it is difficult to characterize such presumption; in trade circles, it might be termed "sharp practice."

In 1927, Dr. Owre became dean of the School of Dental and Oral Surgery of Columbia University. Since that time, many of his activities have carried with them dangerous potentialities for the dental profession. First was the inauguration of a series of measures apparently intended to convert the School of Dental and Oral Surgery of Columbia University into a department of the medical school. The following facts indicate that the school has been directed far on its road toward such a relationship:

1. Oct. 12, 1928, the following statement was made by Dean Emeritus Samuel Lambert at the dedication exercises of the Columbia-Presbyterian Medical Center, and was subsequently published in a booklet issued by the Fund Campaign Committee of the Dental School of Columbia University:

This medical center is recognizing as a branch of medicine the closely allied specialty of dentistry, and the inclusion of the school and clinic for dental and oral surgery marks a new departure in the organization of a university school of medicine.

In other words, the Columbia-Presbyterian Medical Center considered that the specialty of dentistry is a branch of medical practice, and the dental school and clinic are included in the organization of the medical school.

2. In a bulletin issued by the Joint Administrative Board of the Medical Center, Sept. 28, 1928, appears the following statement:

In the interests of maintaining a high standard of dental teaching and of eventually making dentistry a specialty of medicine, the classes in the dental school are to be limited to sixty students.

It is a fact that the *dental faculty* desired to admit 100 students, but their wishes were vetoed. This seems to indicate that the control of the most important policies of the dental school are vested in the medical school. As evidence that the quotation referred to may be questionable in sincerity, it can be pointed out that the classes in the *medical school* of the same university admit 100 students or more. Under the circumstances, we are justified in coming to one of two possible conclusions—either the *medical school* does not attempt to "maintain a high standard of teaching," or else it is not necessary to limit the *dental school* to

sixty students to maintain a high standard of teaching. We can accept, however, the statement that the limitation to sixty students is also for the purpose of "eventually making dentistry a specialty of medicine."

3. As further evidence that the dental faculty does not possess full authority, on *purely dental matters,* the fact is submitted that the professors of the school had their titles changed without their consent, in order to do away with the effect of subdividing dentistry and dental teaching into specialties. Thus, the titles of professor of orthodontia, professor of prosthodontia and all similar ones were done away with, and all members of the professorial staff were designated as professors of dentistry, associate professors of dentistry, assistant professors of dentistry, etc. By this titular change, the list of the dental faculty conformed with the departmental idea, and, at the Medical Center, there were then professors of dermatology, professors of ophthalmology, professors of physiology, professors of chemistry, professors of dentistry, etc.

4. The advanced courses for dental practitioners given at the school are announced in a small folder, on the back page of which appears the heading "Administrative Board on Graduate Studies *in Medicine.*"[1] This board consists of fifteen members, most of whom are members of the medical faculty, only three being members of the dental faculty. It is significant that the courses are under the supervision of the administrative board on *graduate studies in medicine.* In other words, postgraduate teaching of dentistry, also, is under the administration of the medical faculty.

5. The name of the dental school, unlike that of the medical school, is not in evidence on the outside of the building that it occupies, and the external of the building carries no suggestion that a dental school exists in the Medical Center of Columbia University. This lack of recognition of the desirability of so dignifying the dental school is but another indication of its trend toward a departmental status.

Dr. Owre's next move toward accomplishing his purpose was to oppose efforts of an organized representative group of dentists to express the opinion that the interests of all concerned could best be served by *continuation* of the dental profession as a separately organized body, as outlined in the findings of the Carnegie Foundation's study of dental education previously quoted.

The following facts substantiate this allegation: The Dental Center Committee of the New York Academy of Dentistry was appointed in April, 1927, to investigate the possibility of establishing some type of headquarters for dental activities in New York City. Finding that doubt existed in important quarters regarding the future of the dental profession, the committee believed it desirable to obtain an expression from the Academy on the issue and for that purpose introduced the following resolution:

WHEREAS, there are current expressions of doubt as to the future status of dentistry, and

WHEREAS, such a condition is detrimental to dental progress and constructive effort in its behalf, and

WHEREAS, dentistry as a profession is on the threshold of most important advances and opportunities, and

WHEREAS, any impairment of dentistry's present responsibility, or obstruction of its free development, would prevent attainment of its greatest usefulness; therefore, be it

Resolved, that the New York Academy of Dentistry records its conviction that the requirements of Oral Health Service will more effectually be met if Dentistry continue to grow as a separate profession, and be it further

Resolved, that the New York Academy of Dentistry considers that "Dentistry," like the term "Medicine" should carry broader meaning as the quality of its service undergoes expansion.

At a subsequent meeting, Dr. Owre took the floor and in a heated, emotional attack, in which he was supported by some of his faculty, opposed the adoption of the resolution.

The following is a quotation from a letter sent by the chairman of the Dental Center Committee to Dr. Owre under date of March 6, 1929:

When opposition developed to the original report of the committee, I found that the opponents of the measure were practically all associated with the Columbia Dental School. In discussing the resolution, on the floor and privately, they did not argue on the principle involved; namely, "that dentistry should CONTINUE as a separately organized profession," but instead, deprecated the resolution as "being most unfortunate at the very time when Columbia was seeking funds for its dental school," and stated that "the resolution was uncalled for," that "its adoption would be an affront to the medical profession," and that "it would undo the efforts of those who have been seeking to bring about more general cooperation between the dental and medical professions, etc." I could not comprehend this anomalous attitude until some of the developments in the school came to my attention. I then became convinced that the school and some of its executives were quietly in frank disagreement with the principle underlying the report of the committee, and that the opposition was based upon this fact, and not upon the reasons that had been openly expressed. It then became apparent, also, that some of the members of the faculty were obviously embarrassed by the situation, for they had to choose between following the doctrines of the Dean of their school, or remaining consistent with their previously expressed ideas on the subject.

In Dr. Owre's reply, under date of March 13, 1929, appear the following two statements:

I am not in favor, and never was, of the *immediate* inclusion of dentistry in medicine; but thirty odd years of dental, medical and educational experience have convinced me that ultimately the two must in some way come together.

My point in the whole matter is that we should await developments, while correcting wherever possible obvious deficiencies in dental education, without "sewing up" the profession by any action tending to crystallize its status.

The word "immediate," underlined by Dr. Owre with pen and ink, indicates that he favors the inclusion of dentistry in medicine, not immediately (because there is no way of doing it immediately), but as soon as it can be brought about.

It will be noted that Dr. Owre urges the dental profession to do nothing toward crystallizing its independent status, while those, including Dr. Owre who would include dentistry in medicine (not immediately), are doing what they can to bring about the status which they desire.

The New York Academy of Dentistry subsequently adopted unanimously, with Dr. Owre present but not voting, a substitute resolution containing exactly the same principle as the original, and modified only to the extent of including some complimentary references to the medical profession and the necessity for cooperation with it—expressions that seemed so elementary and obvious that they were not included in the original resolution.

In substantiation of the statement made that doubt exists as to the future status of the dental profession, the following facts are submitted:

1. The president (layman) of an educational foundation, unwilling to do anything to help dental schools because, in his personal view, "dentistry should be a specialty of medical practice," has indicated gratification that a Class A dental school was discontinued instead of being included in a newly created university "medical center" (which, however, has a

dental service in the hospital). He has also expressed the belief that "the early discontinuance of all dental schools would be desirable," as this "would hasten the conversion of dentistry into medicine."

2. The director (physician) of a large fund for the advancement of health service, when urged to support dental research, was unable to see the public need in dentistry as anything more than the solution of a series of problems in pathology that could best be studied in laboratories of pathology, "especially in medical schools *in universities having no dental schools.*"

3. The director (layman) of an important phase of health service under the auspices of a national foundation, which has given large sums to promote public welfare, after considering detailed proposals for the creation of a new dental school in a university and consulting his dentist (D.D.S., M.D.), declined to act, saying that "dentistry is only a trade, and the part requiring endowment should be included in medical practice and taught in medical schools."

4. The president (layman) of a leading establishment for the support of public health work, when asked to note the need for endowment of dental schools, expressed the view that "the *best* of the work in dental schools should be included in medical schools" and that "the *rest* of the work in dental schools is not important."

5. The dean (physician) of a medical school, one of the most influential officers in his university, in discussing the desirability of organizing a dental school, said, in accord with the advice of oral surgeons in the hospital service, that he would approve the creation of a dental "school," if it were made a *department* of the medical school. In that event, he said, it could be "controlled by the medical faculty," the number of students to be admitted could be "kept as small as the medical faculty desired," and the "award of the D.D.S. degree could be avoided."

6. The dean (physician) of a *medical* school in a university containing a dental school has expressed the opinion, in accord with the views of the senior oral surgeon in the university (D.D.S., M.D.), that no dentist should be permitted to practice any phase of oral surgery, including general anesthesia, unless he holds the M.D. degree, and that statutory dental practice should consist only of what oral surgeons would not wish to include in their service. In the state in which this university is located, an officer in the state department of education has been told privately that this is "desired" by the university thus represented, although he has learned that the dental faculty was not consulted regarding the matter.

In 1929, the American College of Dentists submitted by mail, to its entire fellowship, the following resolution which was adopted by a vote of 254 to 13:

"WHEREAS: The American College of Dentists is cognizant of the opinion and sentiment, expressed in certain sections of this country, that dental practice could more effectually fulfill its functions by becoming an integral part of medical practice; and

WHEREAS: It is being represented that this opinion is held or endorsed by a considerable portion of the dental profession; therefore, it is hereby

Resolved: That the American College of Dentists records its conviction that the above mentioned opinion does not represent the views of more than an extremely small minority of the members of the dental profession; also

Resolved: That dentistry, which has evolved during the past ninety years as a natural and distinct division of health service, can best meet the needs of mankind by the further development of its ideals and service through separate and special educational activities, professional practice, and statutory regulation; also

Resolved: That the existing personal and professional cooperation and mutual helpfulness between dentists and physicians, and between dentists and practitioners of other kinds of health service, should be continued and strengthened, and that, in harmony with the objects and history of the American College of Dentists, suitable means should be taken by the College at all times to further this accord; also

Resolved: That the present officers and committees of the American College of Dentists, and those hereafter to be selected, are authorized to state publicly the facts and convictions in these resolutions, whenever and wherever it may be appropriate and desirable to present them.

Incidentally, it might be mentioned that Dr. Owre, a Fellow of the College, received a copy of the resolution and recorded his vote on it.

In May, 1929, the Dental Society of the State of New York unanimously passed the following resolution:

Resolved: That the Dental Society of the State of New York, an organization dedicated to the best interests of the dental profession and the public it serves, aware of the discussion in progress for some years on the most effective means of advancing dental practice, hereby expresses the earnest conviction of its members that the most effectual development of oral health-service will be insured by the CONTINUANCE of dentistry as a separately organized profession; and be it further

Resolved: That in taking this action, the Society also records its unabated desire and intention to promote personal and professional accord, cooperation and mutual helpfulness between dentists and the practitioners of medicine and all other kinds of health service.

Despite the almost unanimous actions taken by these important dental organizations, Dr. Owre has the temerity to write:[4]

Moreover, I know personally a great many dentists, among the best trained and most intelligent of the profession, and a great many leading physicians, who favor the ultimate inclusion of dentistry in medicine. There is by no means an altogether "prevailing view" against such an eventuality.

During this same general period, Dr. Owre, possibly working on the thesis that destruction is facilitated by disorganization, undertook the following procedures, which, had they been successful, would have destroyed established representative organizations in dentistry:

1. In March, 1928, Dr. Owre circulated a resolution proposing Columbia's resignation from the American Association of Dental Schools. Vigorous opposition led to the withdrawal of the resolution before it was brought to a vote.

2. In November, 1928, at a conference of the deans of the dental schools registered in New York State, Dr. Owre urged unsuccessfully that their schools withdraw from the American Association of Dental Schools.

The full significance of Dr. Owre's activities in these instances is indicated by the importance of the American Association of Dental Schools, as shown in the following paragraph from Bulletin No. 19 of the Carnegie Foundation:

During the summer and fall of 1922 there arose, among the dental schools in the United States and Canada, a general desire for unification of efforts to advance dental education. In accordance with this sentiment, five officially instructed and empowered delegates each from the Canadian Dental Faculties Association, the American Institute of Dental Teachers, the National Association of Dental Faculties, and the Dental Faculties Association of American Universities, in joint session in Omaha, on January 23 and 24, 1923, unanimously amalgamated these bodies provisionally into the American Association of Dental Schools. As stated in its constitution, this Association was organized "to facilitate intercourse and conference among teachers of the dental sciences and arts in North America; to promote advancement of teaching and research in American schools of dentistry; to encourage

4. Report of the Dean of the School of Dental and Oral Surgery of Columbia University, 1930.

thorough study and discussion of the needs and problems of dental education; to improve public understanding and appreciation of the quality and value of dentistry; and to maintain dental education in full accord with the highest requirements of professional education in the public service." . . . At its first special session, held in Cleveland, on September 11, 1923, the provisional consolidation was made permanent.

3. Failing to observe signs of disorganization of the American Association of Dental Schools, Dr. Owre turned his attention toward another representative body filling an important rôle in dental education. In March, 1929, Dr. Owre called a meeting in Chicago of a selected group of deans of dental schools, for the purpose of organizing a movement intended to result in the withdrawal by the American Association of Dental Schools of its representatives in the Dental Educational Council of America. A copy of the proposed resolution was sent out by Dr. Owre with the call for the meeting. The Dental Educational Council of America consists of five representatives from the American Association of Dental Schools, five from the National Association of Dental Examiners and five from the American Dental Association. It is an interesting fact that Dr. Owre was a member of the Dental Educational Council of America until his association with that body was terminated by a vote of his colleagues in the dental faculties; since which time, he has lost no opportunity to express his contempt for the organization.

4. It is pertinent to point out that he is not a member of the First District Dental Society of the State of New York nor of the Dental Society of the State of New York. These are the organizations to which practically all reputable dentists in New York City belong, and the absence of Dr. Owre's name from the membership roll indicates his real opinion of dentists and the dental profession. Probably, no other dean of any university dental school in the country shows such an offensive attitude toward the dental profession.

5. Recently, Dr. Owre resigned his membership in the International Association for Dental Research, a scientific organization founded in 1920 for the stimulation and advancement of dental research. Although Dr. Owre resigned without giving a reason, it would seem to be a fair assumption, in view of his recent history, that the act was just one more in the process of converting his separation from dentistry into absolute divorce. Dr. Owre, as dean of a dental school, should by example and precept be a staunch supporter of the cause of dental research. If Dr. Owre's activities "in" the dental profession are to be accepted as ideal by the dental students of his school, and a dean should so conduct himself, we would find the graduates from the dental school of Columbia University shunning dental organizations, and withholding interest and support from organized dental research.

In October, 1929, at the annual convocation of the American College of Dentists, a member of Dr. Owre's faculty made a formal statement in which he denied the allegations previously made before that body to the effect that Dr. Owre stood for the inclusion of dental practice in medical practice. The statement obviously represented the opinion of the dean, and this was confirmed later by the committee on Education, Research and Relations, to which the statement had been referred.

Dec. 28, 1929, Dr. Owre sent to the deans of all the medical schools a letter in which he asked for a reply to the question "Is medicine ready to re-adopt dentistry, all or in part?" In March, 1930, at

the Toronto meeting of the American Association of Dental Schools, its President, Dr. Seccombe, referred in the annual address to this action of Dr. Owre's as follows:

> There never was a time in the history of dentistry when there was greater need for loyalty, clear thinking and united effort on behalf of the profession. There are forces at work that seek to bring about the division and disintegration of dentistry as at present constituted. Dentistry has made wonderful progress on this continent in the past sixty years, and I believe the profession is on the threshold of an even greater development. There is no need for our branching out into neighboring fields. There is within the present bounds of the profession ample opportunity in dental research, dental education and dental practice to tax to the utmost all of the ability and energy that we possess.
>
> Let us progress toward our ideal of the profession of dentistry, inclusive of all that is essential of the fundamental sciences, and with its members prepared by training and experience to give to the people a complete dental health service. Let us unite within the profession all branches of practice necessary to supply this service, that we may by cooperation and unification serve the public in the most acceptable way.
>
> During the past year a member of our profession sent a letter to the deans of medical schools in the United States and Canada asking for the views of medical educators on the probable future of dentistry and dental education, stating his belief that education on varying levels in some of the professions is inevitable and that dentistry, at least in certain phases of it, is a specialty of medicine. The writer of the letter then asks of the faculties of medicine: "Is medicine ready to adopt dentistry all or in part?" Personally, I feel that there should be within the dental profession the broadest spirit of tolerance and a disposition to allow one another to present within the councils of the profession varying views regarding the present and future status of dentistry. I think, however, that such a communication should never be forwarded by an individual but by an official body, and only when it carries with it the judgment of the profession.

Dr. Owre, in a recent paper,[5] makes the following comment on the foregoing quotation:

> President Seccombe's astounding effort to muzzle individual initiative provoked heated objection from the deans of several leading university schools, and very nearly disrupted the association.

The foregoing statement is not quite complete. The facts, briefly, are as follows: The President of the American Association of Dental Schools, aware of Dr. Owre's letter to the medical deans, and believing that such representations, if desirable, should be made to the medical profession through official bodies within the dental profession, criticized the action of "a member of our profession" (Dr. Owre) who had seen fit to represent himself as the spokesman for the dental profession. Dr. Seccombe's address was referred in the usual routine to a committee which brought in a report, not only endorsing, but also emphasizing the president's views. After a reading of this report, a discussion ensued, followed by a motion to the effect that the President's remarks (quoted above) be incorporated in the committee's report and that the report be adopted. *The motion was carried with practically no dissent; the American Association of Dental Schools thereby specifically voting to place itself on record as endorsing its president's criticism of Dr. Owre.* Dr. Owre's statement that the situation "very nearly disrupted the Association" can be most charitably characterized as an obvious exaggeration. In view of Dr. Owre's other recent activities, it seems fair to comment that possibly "the wish was father to the thought."

By May, 1930, Dr. Owre, possibly stimulated by the general opposition his views had developed in the dental pro-

5. Is Dentistry at the Cross Roads? Dent. Cosmos, 72:1069 (Oct.) 1930.

fession, became less ambiguous than previously and made bold to present before a group of orthodontists a paper entitled "Is Dentistry at the Cross Roads?" The paper was a reiteration of his advocacy of including dentistry in the practice of medicine. The editorial comments the paper inspired in important dental periodicals were pointed enough to indicate that the dental profession feels that the title of Dr. Owre's paper should have been "Is Dentistry at the *Double Cross* Roads?"

In October, 1930, there was published in pamphlet form by Columbia University the report of Dean Alfred Owre to the president for the period ending June 30, 1930. The report, in which the dental profession is seriously discredited, may be considered as an up-to-date résumé of his views.

The following extracts from the report lead one to wonder whether Dr. Owre's views have been colored by dentophobia, or if in discussing dentistry's problems, his logic may be interfered with by a strabismus possibly due to an effort to keep one eye on dentistry while keeping the other eye strained in the direction of the medical grandstand.

On page four of the Dean's report to the president appears the following statement:

> There has been a marked gain in the growth of the clinic idea, despite organized opposition by dentists who feel their often unearned financial gains threatened, and the more reactionary ethical and qualified members of the profession who mistakenly fear a decline in personal prestige through the growth of dentistry into a specialty of medicine.

This statement attacks the motives actuating those who have opposed not the *"clinic idea"* but the principles under which the so-called *teaching clinic of the School of Dental and Oral Surgery of Columbia University is conducted.* A regrettable unfairness, much in evidence throughout the entire report, is typically shown by his grouping into two classes all those who oppose Dr. Owre's *method of conducting a dental clinic.* In the first group, he puts those dentists "who feel their often unearned financial gains threatened," and, in the second, he puts the admittedly "ethical and qualified members of the profession who mistakenly fear a decline in personal prestige." Dr. Owre thus ignores that large group of members of the dental profession who actually fall into neither of these groups, who are not against the *"clinic idea,"* but who are opposed to the *Owre service clinic idea* for the following reasons:

1. The fact that, in many instances, the fees charged in his clinic are high when compared with the fees prevalent in middle class private practice; it being a fact, for instance, that the fees charged for some orthodontic services are higher than those charged by some of the younger practitioners of the specialty of orthodontia.

2. The fact that Dr. Owre has not publicly disavowed newspaper articles emanating from a member of his faculty, attacking the quality of service rendered by private practitioners, and intimating that it would be much safer for the public to patronize the school clinic. This unjustifiable attack, which has undoubtedly undermined the confidence of the public in the dental profession, fails to take into consideration three points:

> (*a*) The fact that a dentist is operating in Dr. Owre's dental clinic instead of in his private office does not convert an incompetent dentist into a competent one. If it is possible for a dentist to perform scientific dentistry in the school clinic, the same dentist could perform equal or better service in his private practice.

(*b*) While the dental profession undoubtedly has a percentage of individual members whose operating is a menace to public health, this same fact is undoubtedly true of the medical profession, and yet it is not proposed in the public press that patients avoid going to private medical practitioners.

(*c*) The element of human fallibility is not peculiar to the dental profession.

In April, 1930, the First District Dental Society, after an investigation, passed a resolution condemning the *type* of dental clinic conducted in the Columbia dental school. Dr. Owre, in commenting to a newspaper reporter on this action, petulantly characterized most of the New York City dentists who had voted for the resolution as "tradesmen and hucksters." These irascible remarks were published in the lay press, with an effect on the public that undoubtedly was not conducive to an elevation of its respect for the dental profession.

On page 7 of the report, in referring to the establishment of a division of children's dentistry, Dr. Owre states that "the department is in charge of a doctor who is both a graduate dentist and a pediatrician." There are no quotation marks surrounding the word doctor in this instance, although throughout the rest of the report, whenever the word doctor is used in referring to a practitioner of dentistry, the sarcastic slur of quotation marks is present. The legislatures of every state in the union have legalized the dental degree, and have authorized the use of the term "doctor" by practitioners of dentistry. It should not be necessary to point out to Dr. Owre that the term "doctor" should not be used when the term "physician" is intended, for both physicians and dentists and the many holders of a variety of other degrees are legally doctors. One is a doctor of medicine, another is a doctor of dentistry, another a doctor of philosophy, and so on. Dr. Owre's derisive reference to the word "doctor" as applied to dentists not only is an offense to every practitioner in the profession, but also is an inconsistency in respect to the granting of the dental degree to the graduates of his own school.

Another example of Dr. Owre's unfairness to dentistry, and his implied perfection in other quarters where it does not exist, is indicated by the following statement from page 16 of the report. "There is much false 'research' and public advocacy by 'doctors' of worthless powders, pastes, and other cosmetics." While it is true that dentists have been known to publicly advocate powders and pastes, etc., of doubtful value, the most ardent medicophile would not deny that there are many more examples of such testimonials from the medical than from the dental profession.

Another instance of unfairness is evident in the following quotation: "Cases received every day in the teaching clinic of the School illustrate locally the results of ignorant, even venal, operations." Again, one need only refer to the records of the medical and surgical clinics in any hospital to find that the same unfortunate evidence is presented daily of "ignorant, even venal, operations" in unskilled and unprincipled medical and surgical practice. Nothing in these remarks is intended in any way to reflect upon the high caliber of public service rendered by the members of the medical profession, and that profession is mentioned only because Dr. Owre would have it believed that if dentistry became a part of the medical profession, all unskilful dental treatment would automatically cease.

On page 16 appears the following: "It is urged . . . that we should preserve the glorious independent institution of American dentistry." The gratuitous sarcasm in this statement richly deserves the

resentment its publication has engendered, for an honorable name and an enviable record have been made by American dentists throughout the world.

A further quotation from page 16 follows: "Politicians, always to be found in any group, are too much in the saddle [in dentistry], and the rights of the public to scientific oral care suffer, as always, in consequence." It is an interesting observation that when Dean Owre attempts, through political maneuvering, to accomplish certain of his purposes, he wishes it to be understood that his activities are idealistic; but those entirely altruistic individuals who may resort to concerted opposition to Dr. Owre's aims, because they are not in accord with them, he classifies as "dental politicians." In all large organizations, there is parliamentary maneuvering on the part of groups sincerely desirous of accomplishing good ends, but differing in point of view as to the best method of accomplishment. Dr. Owre's habitual use of the epithet "dental politicians," to account for and explain away opposition to his ideas, is a "shotgun" procedure that seems to be resorted to in lieu of logical argument. It reminds one of the attitude of the petulant child who, not being allowed to have his own way, gives no reasons why he should have it, but instead begins to call his playmates "names."

Dr. Owre maintains the idea that the ideal dentistry of the future should be practiced by a physician (master) and a group of technicians (servants).

The following is from his earlier writings advocating this theory:

> This is the fundamental necessity—to train specialists in the mouth region, capable of diagnosing and prescribing for ills of the mouth. For the mechanical work involved in the care of the mouth it is possible to train men in much less time than is required for the oral specialist, and in much greater numbers. These men should work only under the direction of the oral specialist; and the latter should relegate the mechanical phases of oral treatment to the trained mechanic. It were as logical to borrow an analogy from a noted scientist, to expect an eye specialist to make all glasses for which he writes prescriptions as to require an oral specialist to fill, clean, or otherwise mechanically treat all teeth his diagnosis finds faulty. *This, briefly, is the hoped-for-future of dental education.*[1] How soon, and in what manner, this will come about depends largely on the findings of the Carnegie Survey of Dental Education, now in progress.[6]

On page 17 of Dr. Owre's report, he quotes a medical dean as follows:

> I asked some dentists not very long ago how many men a competent dentist could supervise, and the answer was "Oh, twenty, with the greatest ease!"

Commenting on this quotation, Dr. Owre states:

> If this is true under present chaotic conditions, it is equally true that with a highly trained doctor-type—a diagnostic type—many more assistants could be kept busy. It would be somewhat more expensive to educate such a doctor. The men under him, however, could be trained quickly and in large numbers. *If they were taught in laboratories under university supervision they would be a more responsible group than most of those now operating.*[1]"

By consolidating the various statements made by Dr. Owre regarding the type of intra-oral technician who would work under supervision, we find that "one doctor, with both medical and dental training could direct and keep busy at least twelve assistants of various types . . . These need only the minimum common school training required by law . . . They can be technically trained in one year or less . . . to perform intra-oral general dental operations. It is of importance to note that these "assistants" are not to be confused with the present day laboratory technicians who perform only extra-oral

6. A View of Dental Education, Minneapolis Dist. Dent. J., September, 1922.

services. In passing, it seems fair to assume that dental hygienists also would, in the future, have this same low educational level.

As pointed out earlier in this paper, the Carnegie Foundation, in its study of dental education, examined the various plans projected for changing the general status of dental education. This "master and servant" plan advocated by Dr. Owre was advanced a decade or more ago by others, and was rejected by an almost unanimous opinion of the many advisers of the Foundation as impracticable. The physicians who had been interrogated as to the value of the plan opposed it just as vigorously as had the members of the dental profession, for they felt that if the scheme were applicable to dentistry, it would also be applicable to medicine, and that its adoption would very rapidly bring about complete disruption of the entire system of *personal* health service. The physicians believed that the plan would be just as practical if adapted, for instance, to one diagnostician (master) aided by a group of one this, one that and so on, all trained to do particular procedures under the master's assignments.

If the "one to twenty plan" advocated by the medical dean previously referred to, and endorsed by Dr. Owre, were to be put in practice, we would find that the 70,000 dentists in the United States and Canada would be succeeded by about 3,333 physician-dentists (masters) and 66,667 technicians (servants), and the latter would have only the meager preliminary education suggested by Dr. Owre.

At a time when panel medicine and dentistry are being imposed on the professions in Europe, and when efforts are being made to bring about such a deterioration in *personal* health-service in this country by suggestion of similar legislation, it seems most unfortunate that Dr. Owre should be found advocating the procedure that might lead directly to it. Misguided sociologists would find in the "one to twenty" plan encouragement for imposing state dentistry in this country. They would argue logically that, in order for the state to control dental practice in its entirety, it would require only state control of a comparatively few "masters."

CONCLUSIONS

The foregoing evidence, in the opinion of the writer, indicates that

1. Dr. Owre is opposed to a continuation of the present separately organized dental profession.
2. Dr. Owre's attitude on the question has received no endorsement from organized dentistry.
3. Dr. Owre has unfairly exaggerated the shortcomings of the dental profession.
4. Dr. Owre's failure to acknowledge the presence of much of anything good in the dental profession and his tendency to find nothing but perfection in the medical profession should cause his proposals regarding either profession to be regarded with skepticism.

ADDENDUM

While the writer disagrees vigorously with the thesis that the interests of the public and of the dental and medical professions would best be served by the inclusion of dentistry in the conventional practice of medicine, no attempt has been made in this analysis to argue the many points involved. The only purpose hoped to be served by this presentation is the focusing of attention on the writings and activities of Dr. Owre, so that it may be made apparent that a definite movement has been launched seemingly for the purpose of destroying the autonomy of the dental profession.

It should be made clear, however, that it is the sole prerogative of the dental profession to make the decision in regard to any change in its status. If it favors the proposals that dentistry become a part of the practice of medicine, then it should at once assist in every way those who are striving to bring such a change about. If, however, the dental profession decides to continue its progress and develop further the quality of its service as a separately organized profession, it must arouse itself, defend its professional program, identify its antagonists and, by an overwhelming demonstration of unity and determination, destroy the potency of those forces which would inflict a contrary will on an unwilling majority.

TECHNIC OF FILLING THE CANALS OF PULPLESS TEETH WITH DENTINOID AND LEAD*

By J. P. BUCKLEY, Ph.G., D.D.S., F.A.C.D., Hollywood, Calif.

THE operation of filling the canals of pulpless teeth stands as a sort of dividing line between the subject of dental therapeutics proper and operative dentistry. For years, I have been actuated by the belief that therapeutics was of sufficient importance in dental practice to occupy a place by itself, and through the years I have labored with others to divorce the subject from operative dentistry, to which it had long been subordinated. The efforts along this line have not been in vain.

Today, dental therapeutics is occupying a prominent place in practice, and the operation of filling the canals of pulpless teeth stands first in importance among the many which the dentist is called on to perform. From sad experience, we have learned that the success of the operation depends upon the observance of details, many of which have heretofore been considered more or less nonessential. The sooner the profession learns that every detail is essential in the successful performance of the operation, the better it will be for all concerned. Unless we are willing to spend the necessary time to do this work well, it should not be undertaken at all. Carelessness has brought failure, and consequently the deserved criticism of the past. I shall attempt to show that it requires no more skill to do this work as it must be done today than is required for almost every operation that we are called on to perform.

The surgery of root-canal treatment has been developed in recent years to such a high degree by different men and by varying methods that little else is needed along this line. The importance of properly preparing the canal for the final filling cannot be overemphasized, for we should never attempt to fill any canal that has not been explored to the apical end, properly opened and sterilized. To consider how this should be accomplished is

*Read before the Section on Physiology, Histology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 23, 1930.

not the intent of this paper. I shall confine myself strictly to detailing a method of filling the canal after the root and, if necessary, bone surgery, a method which is absolutely positive, eliminates all guesswork and brings to the operator a satisfaction not heretofore experienced.

In the past, a great variety of materials have been suggested and used for filling the canals of pulpless teeth, and the method employed depended largely on the material used in the operation. For a long period of years, guttapercha, modified and used in such a manner as to best meet the demands of the individual operator, has been the material on which most reliance has been placed; and the roentgenogram has proved that this material can be successfully employed. It has always seemed to me that the greatest hazard in using guttapercha is the difficulty one encounters in firmly compressing the material in the canal with the necessary solvents and heat without forcing some of the softened material past the end of the root.

A factor in this relation which has not been sufficiently stressed in the past is the fact that a root overfilled, especially with a foreign material such as guttapercha, even though the operation is aseptically performed, is likely to act as a mild irritant, stimulating bone formation, with resultant hyperplasia or hypercementosis. This may or may not produce trophic disturbances such as neuralgia and a possible neuritis, and may cause a neoplasm which is not always disclosed in the roentgenogram.

Fig. 1.—Lead point used as diagnostic or measuring wire.

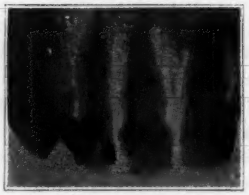

Fig. 2.—Lead point shown in Figure 1, cut off and used with dentinoid for the final root canal filling. In this case, a labial infiltration of procain was made over the apical end of the lateral incisor, the pulp removed painlessly, and the canal cleansed with phenolsulphonic acid and filled with dentinoid and lead at one sitting.

Fig. 3.—Canal filled with plastic dentinoid ready for the insertion of the lead point. The material is radiopaque.

Fig. 4.—Final filling after the lead point is inserted.

In the filling of a root canal, therefore, it is hazardous to use a material which cannot always be kept under definite control and with which the canal can be filled just to and only to the apical end. In clean cases, where there has been no infection in the periapical region, it is best to have the root filling stop at the dentinocemental junction. It was with this in mind that Grove, Rickert and I, and others, have endeavored to give the profession a material which would eliminate this hazard. With the materials and technic which I am about to describe, we always know exactly where we are going and the results in every case are certain and positive.

About nine years ago, I developed a new material for the purpose called dentinoid. For the first few years, I advocated using the product in connection with guttapercha points. By this means, we were able to use guttapercha without the use of the heretofore necessary solvents and heat to make the material adherent and plastic; and, as is generally known, it was these solvents and heat that caused the shrinkage of the material after it was packed in the canal. Guttapercha as such does not shrink. During the last four years, I have substituted lead points for the guttapercha points to be used with dentinoid, and it has materially simplified the technic of the operation. It is this method that I shall now describe.

Fig. 5 (Case 1).—Case to be re-treated for jacket crown.

Fig. 7 (Case 1).—Canal filled with plastic dentinoid ready for lead point.

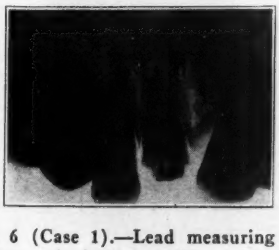

Fig. 6 (Case 1).—Lead measuring point after removal of old root filling. This point needs to be cut off a little.

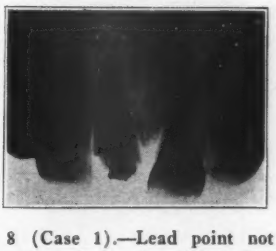

Fig. 8 (Case 1).—Lead point not quite reaching the apical end, which is filled with plastic dentinoid.

First, let me repeat what has been published heretofore, that dentinoid is a purely physical mixture of calcium phosphate and barium sulphate, with such drugs as thymol, thymol iodid and orthoform and an inert resinous binder. This makes a yellowish powder which is to be

made plastic by the addition of a few drops of alcohol at the time the material is used for filling the prepared canal. There are only a few precautions to be observed in mixing dentinoid for use. A long series of experiments has shown that, for satisfactory results, the binder must be present in the powder in a certain and definite proportion; and, in the mixing process, it should be remembered that alcohol freely dissolves the binding substance. Alcohol is thin in character and flows easily, and if care is not taken in making the mix, a certain amount of the binder will be removed by the liquid's flowing through the powder and spreading over the slab, thus altering the properties of the product and changing the formula to this extent. *This must be avoided.*

In mixing, therefore, place the desired amount of dentinoid on the slab and make a concavity in the center into which the selected liquid may be added by drops from a small glass medicine dropper, the powder being incorporated as the liquid is thus added. It is necessary to spatulate the mix just enough to produce the desired consistency for convenient handling, and to bring the varnish, formed by the binder dissolving in the liquid, into contact with the insoluble bulk of the powder (calcium phosphate and barium sul-

Fig. 9 (Case 1).—Plastic dentinoid in apical area after forcing lead point home as shown in Figures 7-8.

Fig. 11 (Case 2).—Initial treatment of formocresol.

Fig. 10 (Case 1).—Dentinoid in apical area resorbed after eighteen months.

Fig. 12 (Case 2).—Lead point used as measuring wire.

phate). More liquid or powder may be added, if necessary, to accomplish this end without danger of destroying the virtue of the product when set. Keep in mind that dentinoid is a purely physical mixture before and after mixing; it is not a chemical compound or a dental cement.

Before making the mix preparatory to filling, a lead point should be selected, sterilized by immersion in alcohol and fitted in the canal. The selected point should approximate the size of the canal as judged from the size of the twist broach used in the opening process, and may be used as a so-called "diagnostic" or measuring wire (Fig. 1). The case should now be roentgenographed. If this can be done in the office at the time, it is seldom necessary to remove the rubber dam. With a little experience, one trial will generally give the desired result, the lead point approximately fitting the lumen of the canal, especially in the apical area, and reaching just to the end thereof. Should the check roentgenogram disclose that the point has not reached the apical end, it means that we have either selected too large a point or that the canal has not been properly explored and opened, and it will generally be found that the latter is the thing to be considered; for, as stated, we are guided in our selection of the trial point by the size of the last twist broach used in preparing the canal for filling. In Figure 1, it will be noted that the lead point is just a little short of the dentinocemental junction. All that is necessary here is to measure

Fig. 13 (Case 2).—Final root filling using the same lead point and dentinoid.

Fig. 14 (Case 3).—Opening made through abutment inlay for initial formocresol treatment.

Fig. 15 (Case 3).—Film taken while canal was being cleaned and checked.

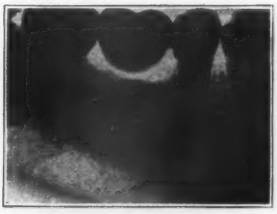

Fig. 16 (Case 3).—Final root filling with lead and dentinoid.

and mark with a small rubber disk on a twist broach the distance from the end where the lead point bent as it projected from the mouth of the canal. Now, we lower the rubber disk the number of millimeters desired to further explore the canal and proceed with the operation.

In the event that the roentgenogram shows the lead point extending beyond

Fig. 17 (Case 4).—Old root filling showing canal not well filled.

Fig. 18 (Case 4).—Old root filling removed, canal cleaned and lead point inserted.

the apex, it will be necessary either to use a larger point or to excise this one as much as it projects into the apical area. If the angle is correct in the taking of the roentgenogram and the length of the tooth is properly registered thereon, we can determine how much to excise the point by measuring on the roentgenogram. It is essential here that the lead point be exactly where we want it to be in the final filling, and I repeat that, with a little practice, and with care and judgment in opening and cleansing the canal, this is generally accomplished at the first trial.

When we are satisfied that the lead point properly fits the canal, it should be grasped with a pair of pliers at the point where it emerges therefrom, carefully removed and cut off about 3 mm. above the mouth of the canal and this portion flattened with a pair of heavy pliers. It should then be kept in an alcohol bath for final sterilizaton until ready to be coated with the plastic dentinoid and replaced in the canal (Fig. 2). The flattened end facilitates handling and also permits the projecting portion to be easily

Fig. 19 (Case 4).—Final root filling with lead point and dentinoid.

Fig. 20 (Case 5).—Film taken before operation, showing a deep cavity under the gold inlay.

bent against the floor of the pulp chamber or the side of the canal in an anterior tooth when finally inserted.

In mixing dentinoid, 95 per cent alcohol should be used and the mix should be quite stiff and plastic. It is presumed that alcohol is the liquid last used in the canal for removing the surface moisture, which is all that is necessary when this method of filling root canals is followed. Some of the alcohol thus used is purposely left in the canal, better results being obtained when the canal is slightly moistened with this liquid. With a suitable instrument, the plastic dentinoid is carried to the mouth of the canal and worked to the apical end (Fig. 3). Now the lead point is taken from the alcohol bath and coated with the mixed dentinoid on the slab and then gently but firmly placed in the canal as far as it will go (Fig. 4). The point acts as a piston or plunger and, if properly selected, will reach nearly to the apical end, forcing the plastic dentinoid into such multiple foramina and lateral openings as may be present and thus filling all space not occupied by the lead itself. The flattened end of the point is now bent over the floor of the pulp chamber, or, if the tooth is an anterior, pressed against the side of the canal. More plastic dentinoid is placed over the point and pressure made with a small roll of cotton or bibulous paper. This absorbs the excess alcohol and compresses the dentinoid around the point in the canal.

When it is known in advance that a post or dowel is to be subsequently fitted into the canal for some necessary restoration, the lead point should be shortened accordingly and only the apical third filled. In these cases, one must be doubly

Fig. 21 (Case 5).—Pulp removed under conduction anesthesia, canals filled immediately with lead and dentinoid. (Film taken about eighteen months after operation.)

Fig. 22 (Case 6).—Pulpless lower second bicuspid.

Fig. 23 (Case 6).—Canal treated and cleaned and lead measuring point inserted.

Fig. 24 (Case 6).—Final root filling with same lead point and dentinoid.

certain that the lead point fits the canal as is finally desired before it is cut off, and here the end should not be flattened as is generally done, but left blunt, so that it may be pressed home with a properly selected root-canal plugger. A small rubber disk should mark the end of the plugger at the point which equals the length of the cut off portion of the lead point. In this way, the lead point can be put to place as the plugger enters the

Fig. 25 (Case 7).—Film taken before operation, showing overfilled root.

Fig. 26 (Case 7).—Film taken during operation, showing dislodged guttapercha.

canal up to the distance of the rubber disk. This requires a little more skill perhaps than is required in the usual cases, but is easily and definitely accomplished if one observes the necessary details. (Case 1.)

In clean cases, as in pulp removal with no periapical involvement, or where no opening has been made by pathologic process or overinstrumentation, it is best to have the point stop just short of the end, with dentinoid beyond. But if there is an opening of any size, however made, the lead point should fit the opening; and, with this in mind, in preparing the canal for the reception of the point, it should be left *as is*—tapered or choke-bored. Thus, when the point is finally introduced, it will close the opening or stop where de-

Fig. 27 (Case 7).—Film taken after final curettement.

Fig. 28 (Case 7).—Appearance after a period of six months, showing bone regeneration.

sired with none of the plastic dentinoid forced into the apical area if the point is cut off on the bias instead of bluntly. As intimated here, Nature has left all completely formed canals tapered or choke-bored, and, in our root canal surgery, we should be careful not to remove or de-

stroy this natural aid in our work. It would almost seem that Mother Nature, in her wisdom, anticipated the progress of civilization and its concomitant tooth decay and pulp involvement, and made this wise provision.

Many dentists today are using both infiltration and conduction anesthesia, as indicated, for the painless removal of the dental pulp. In all such cases, if asepsis

Fig. 29 (Case 8).—Central incisors fractured in an accident, in a patient aged 12 years. The large apical foramina may be noted.

Fig. 30 (Case 8).—Pulps removed under periapical infiltration of procain and measuring lead points inserted.

has been observed in the operation, immediate root filling with dentinoid and lead is especially indicated and advised, and the filling should stop at the dentinocemental junction. If all details are carried out, absolutely no soreness follows. In cases in which the canal is so small that a lead point cannot be used to advantage in combination with dentinoid, the entire canal may be filled with the latter material alone with every confidence of success, and, with the new product, the root filling will be definitely radiopaque (Fig. 3). If it can be done, the canal had better be enlarged nearly to the end, so as to admit the selected point. Should dentinoid alone be used, it should be packed as directed for filling the canals of deciduous teeth.

Fig. 31 (Case 8).—Canals filled after two days with same lead points and dentinoid.

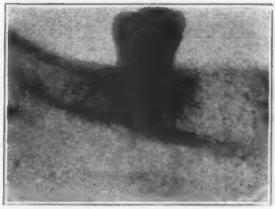

Fig. 32 (Case 9).—Old root filling.

Dentinoid is the ideal material for filling the canals of deciduous teeth. In these cases, the entire canal may be filled with the material alone, which should be placed to the end and compressed firmly with bibulous paper or a small cotton roll. When the canal is thus filled, it should be covered at once with zinc oxychlorid cement and the cavity in the tooth filled at this or a subsequent sitting. In these cases, the dentinoid root filling will

be resorbed with the tooth root, as is also the case when some of the material is inadvertently pressed into the apical area in filling the canals of permanent teeth. This seldom happens with the technic described; but it is satisfying to know that the dentinoid will be resorbed in time should any pass through (Figs. 9 and 10).

Dentinoid adheres firmly to every surface of the tooth structure with which it comes in contact; but should it become necessary for any reason to soften the material in the canal of a tooth, this may be done by simply adding the liquid (alcohol) used in making the mix. This is a distinct advantage which a purely physical mixture has over a chemical combination.

In using dentinoid for filling the canals of pulpless teeth, it should be remembered that the material will become stiff as soon as the liquid is permitted to evaporate, but it requires a few days before the product sets or hardens into a compact solid. In cases in which the root filling need not be disturbed for a post or dowel in some contemplated reconstruction work, it makes no difference about the delayed setting of the dentinoid, as long as it is known that it will ultimately set without shrinkage under the conditions and become extremely hard and resistant. When it is desired to use a post before the dentinoid sets firmly, as previously mentioned, only the apical half or third of the canal need be filled and this covered with zinc oxychlorid or other quick setting cement (Fig. 9).

Fig. 33 (Case 9).—Measuring lead points after canals were treated and cleaned.

Fig. 34 (Case 9).—Final root filling with same lead points and dentinoid.

CONCLUSIONS

The several advantages of the combination of dentinoid and lead for filling the canals of pulpless teeth must be obvious. By this method, the dentin need not be entirely free of moisture; the removal of the surface moisture is all that is necessary. Some of the alcohol used for removing the surface moisture is purposely left in the canal, which in itself is an advantage. Then, too, alcohol has a great affinity for water and the liquids mix in all proportions. This is an advantage in that the alcohol used in making the mix with dentinoid holds in solution the binder and the thymol which, when the plastic material is placed in the canal, are carried into the tubuli to the distance where physical precipitation of the drugs is brought about by the water remaining therein. Thus, the tubules are sealed with an antiseptic (thymol and resin) therein contained, and the foramina and any possible lateral openings are sealed with dentinoid, a hard, firmly adherent, medicated, artificial dentin, which aids

rather than hinders Nature in the healing process. The advantage of using lead points and dentinoid in canals with large apical openings need not be emphasized; and the ease and certainty with which all canals may be perfectly filled to the end, and there only, by this method gives one a satisfaction not heretofore experienced. With guttapercha and the solvents necessary to be used by the former methods in vogue, more or less guesswork was encountered even by our most careful operators. With the technic herewith presented, guesswork is entirely eliminated, and the results in every case, if the canal is properly prepared for filling, are positive and certain. Further to prove this statement, I will briefly describe a few cases in practice, showing the roentgenograms illustrating the technic employed.

REPORT OF CASES

Case 1.—A dentist wished to have the upper central incisor retreated for a jacket crown. Figure 5 shows conditions as case presented; Figure 6, the old root filling removed, canal cleansed and lead measuring point inserted. The point projected a little past the apex and was excised accordingly. Figure 7 shows the canal filled with plastic dentinoid ready for the selected lead point. It being necessary in this case subsequently to insert a dowel with core for the jacket, only the upper two thirds of the canal was to be filled. Figure 8 shows the lead point cut off pulpally accordingly and inserted in the plastic dentinoid in the canal. It will be observed that the lead does not quite reach the apical end, which is well filled with dentinoid. As it was desired to have the lead point farther in the canal and to the end where it was when first fitted and tried, it was pushed home with a canal plugger. The plastic dentinoid was thereby carried into the apical area, as shown in Figure 9. Had the point been cut off on the bias instead of bluntly at the apical end, it would have easily passed through the plastic material without forcing the latter through the end of the root. Figure 10 shows that the dentinoid in the apical area has been resorbed after a period of eighteen months. This is an important property for a root filling material to possess.

Case 2.—The patient, being a prominent young business woman, it was quite essential that a lower lateral incisor be treated and saved; and as the patient was otherwise in good physical condition, there was no good reason why it should not be saved. As is my practice, at the first sitting, formocresol was sealed in the canal with cement (Fig. 11). After twenty-four hours, the canal was explored and cleansed with phenolsulphonic acid. This agent was neutralized from time to time during the process with a 5 per cent solution of sodium bicarbonate. The canal was then desiccated with sterile cotton and alcohol and moistened with formocresol, and a selected lead point, dipped in the latter remedy (formocresol) was placed in the canal and sealed in. As this was a lower tooth it was thought best to remove the rubber dam in order to take a roentgenogram. This film shows that the lead point projects slightly through the end of the root (Fig. 12). At the subsequent sitting, after a period of two days, the point was properly cut off and used for the final root canal filling (Fig. 13). This case was treated in May, 1930, and will be checked from time to time.

As all cases in my practice are treated similarly to this one, only a brief description of those following will be given.

Case 3.—A pulp died in a second lower bicuspid, serving as an anterior abutment for a bridge. Figure 14 shows the case as presented when the patient was referred; Figure 15, the canal being cleansed and checked; Figure 16, the final filling of the root with dentinoid and lead.

Case 4.—In this case, the referring dentist desired to place a jacket on a pulpless upper lateral incisor for a young girl, aged 16. Figure 17 shows that the canal is not well filled, even though the guttapercha point went nearly to end of the root. Note the light line along the guttapercha point. Figure 18 shows that the old root filling has been removed and the canal cleaned. Note the lead point used for measuring the canal. Figure 19 shows the final root filling with dentinoid and the same lead point.

Case 5.—This is a case of immediate root filling, the pulp having been removed under conduction anesthesia. Figure 20 shows a

mesial cavity under a gold inlay, before root operation. Figure 21 was taken after a period of about eighteen months.

CASE 6.—Figure 22 shows a pulpless lower second bicuspid; Figure 23, the lead measuring point; Figure 24, the final canal filling with this same lead point and dentinoid.

CASE 7.—This case was referred because of fleeting pain and suspected antrum trouble from an overfilled cuspid root. Apicoectomy was advised and performed. Figure 25 shows the case as referred. Figure 26, taken during operation, shows a small piece of dislodged guttapercha; Figure 27, the appearance after final currettement. Figure 28 shows complete bone regeneration after six months. Had this canal been filled at the first operation with dentinoid and lead, there need have been no overfilled root and no subsequent surgery. In those cases in which surgical treatment must be given, it is best to have the canal filled with lead rather than guttapercha, for reasons which are obvious.

CASE 8.—As will be noticed from Figure 29, this patient, a boy, aged 12, accidentally broke off the incisal third of both upper central incisors. The horn of the pulp was involved in the fracture. Note the large apical foramens. Pulps were removed under periapical infiltration and selected measuring lead points inserted (Fig. 30). Canals were filled, after two days, with dentinoid and these same lead points (Fig. 31).

CASE 9.—The patient, a dentist, greatly desired to have a lower second molar saved as a distal abutment for a bridge. The tooth had been treated and canals filled nineteen years previously by a senior classmate in college and through the years had carried a large inlay anchored with a post in the distal root (Fig. 32). This inlay was removed, the mouths of each canal were exposed and formocresol was sealed in for forty-eight hours. The old root filling was then removed with xylene and twist broaches, the canals cleansed with phenolsulphonic acid, followed with sodium bicarbonate (5 per cent), desiccated with alcohol, and then the canals were moistened with phenol compound and selected lead points inserted for measuring purposes (Fig. 33). After two days, the canals were filled with dentinoid and these same lead points (Fig. 34).

In these various cases taken from my practice, I have endeavored to select those which cover practically every condition which the dentist is called on to treat.

Let me repeat what I have published recently elsewhere, that if I can read correctly the signs of the times and properly interpret the literature of medicine and dentistry, both professions today are admitting the overenthusiasm of some of their members in the recent past. Many physicians themselves have fallen victims to the craze regarding focal infection in the mouth, and are demanding caution with their patients. Dentistry is on the alert. Everywhere men are investigating and studying the problem as never before; and it is a significant fact that in such places as Illinois and Michigan, where the best research work on this problem is under way, more and more conservatism is evidenced by the profession in relation to the pulpless tooth. All this leads but to one conclusion: the dentist of tomorrow who is not devoting all his time to special practice must either learn how to treat the pulpless tooth correctly and fill the canal or turn this part of his work over to those who will do it correctly. In making these statements, let it be understood that I am not advocating the treatment and retention in the jaw of all pulpless teeth regardless of how badly diseased or without due consideration of the patient's general health. When there is systemic involvement, I am willing to go the limit with the physician in the extraction of questionable and suspected teeth; but the unfounded, inexcusable radicalism of the past, where thousands of innocent teeth have been sacrificed on the altar of ignorance and hysteria, needlessly wrecking the masticatory apparatus of patients by the hundreds, must cease. Nowhere in dental practice is there greater need for the use of those two essential remedies, of which I have spoken so frequently in the past,

"tincture of good judgment and fluid extract of common sense."

DISCUSSION

Lucien H. Arnold, Chicago, Ill.: Dr. Buckley's what I should call "canal lubricant" is very interesting. It is presumably nonirritant. Dr. Buckley says it does not shrink and I believe what Dr. Buckley says. A canal lubricant must be something that will not shrink, that is permanently plastic, that is nonirritant, that is "radiopaque," that is of a nature to *displace* moisture and, if possible, is somewhat of an antiseptic. We can get along without the antiseptic feature if it does not shrink. The thing that we *must* have is a root-canal filling material of *plastic* consistency that remains as it is when inserted; i.e., does not change bulk and is not badly affected by the moisture of the canal, because we cannot dry a canal to the apex. If Dr. Buckley is certain that dentinoid does not shrink, I do not see any use of spending the patient's money and our effort in putting anything such as lead points, guttapercha points, copper points, zinc points or anything else, into the canal. This is the important point that I should like to make: If dentinoid does not change in volume, then nothing further is needed in canal fillings. I hope that at last we have the material that does not require any further time and work in filling root canals, for it is the packing with solids in canal work that takes time, costs money and also splits roots.

PATTERN WAXES AND THEIR MANIPULATION IN CAST GOLD INLAY TECHNIC*

By C. S. VAN HORN, D.D.S., Bloomsburg, Pa.

IT is my belief that pattern wax manipulation is, generally speaking, the most difficult, the least understood and the most carelessly executed step of importance in the entire cast gold inlay process; and, furthermore, that few dentists have given profound consideration to the vital importance of recognizing and taking advantage of the physical behavior of pattern wax when passing through the various temperature conditions and manipulative procedure in the executing of any cast gold inlay technic.

BRIEF HISTORICAL REVIEW

Even a cursory review of the text and advertisement pages of our dental journals reveals the lamentable state of chaos in this art.

Wilmer Souder[1] says:

If there is another problem in dentistry concerning which one can read more and learn less, articulators excepted, I have failed to find it. . . . I am unable to understand the lack of interest by some individuals in consistent, fundamental research looking toward the establishment of standards for materials and technics.

In 1925,[2] I endeavored to show conclusively what occurred when castings were made by technics which ignore the physical behavior of the materials which enter the process. In that series, the material assistance and hearty cooperation of a number of men, prominent in dental casting work, were unselfishly given; and the data, etc., were handled in such manner that no one knew the final re-

*Read before the Section on Partial Dentures at the Midwinter Clinic of the Chicago Dental Society, Feb. 2, 1931.

1. Souder, Wilmer: Selection of Dental Materials, J. A. D. A., 14:189 (Feb.) 1927.

2. Van Horn, C. S.: Dent. Cosmos, 67:159 (Feb.) 1925.

sults until the cooperating laboratory made its report; the paramount object being honestly to segregate truth from fiction, to ascertain definitely, if possible, *what* technic rather than *whose* technic was best and, especially, to determine what was essential to a standardized technic.

To quote from Drs. Taylor and Paffenbarger[3]:

We do not believe it possible to cast an inlay accurately using the Knapp technic and materials. In our hands, the results have been uniformly poor. . . . This casting method has been spoken of as being accurate and standardized. Can a method be considered as such when the temperature of the mold is unknown at all times; the physical properties of the investments are unknown and in this case happen to shrink, and no effort is made to compensate (by expansion of the wax and investment) for the shrinkage of the gold in casting?

The use of a water bath to expand wax patterns for inlays was first suggested by Van Horn. [*Dental Cosmos,* August, 1910.] A picture of his equipment is shown in Figure 17. The method has recently been slightly altered (the ring has been completely submerged; Van Horn may not have had it entirely under the water) and incorporated into other technics which have been widely advertised and heralded as new and profound discoveries. The principles are identical and the practical application is altered in no essential detail.

The following is reproduced from an advertisement clipped from *Dental Items of Interest:*

ANNOUNCING

The Original Water Immersion Technique for Casting Inlays

as developed in collaboration with Major W. S. Rice, Commandant, Dental Corps, U. S. A., Walter Reed General Hospital

Dr. Chas. A. Furrow, Tulsa, Oklahoma, has perfected the most simplified and accurate method of casting inlays ever presented to the profession. Each step of this technique is founded on NEW, but scientific facts. Compensation in every case is provided for shrinkage of gold.

No clamps are necessary. No warming oven. No warming of materials. Invest in ice water, tap water, room temperature water, or warm water. And no expensive equipment.

The results are positive! The castings made for the ten M. O. D. dies (shown below) were cast in 7½ hours. All go to place with finger pressure.

This new technique can be so controlled that castings can be made to fit as desired, and yet so simply that it will be a revelation to you. Write today for your copy of the illustrated booklet under preparation.

COE LABORATORIES, Inc.
6033 Wentworth Avenue, Chicago

To quote from Dr. Rice[4]:

The change in linear dimensions of inlay waxes over the temperature range 77 to 115 F. has been found to be about 0.03 per cent per degree. Differences in the coefficient of expansion of individual waxes for all practical purposes can be disregarded, but the amount of expansion possible is limited by the interval between the chilling temperature and the temperature above which internal stresses are released. The reaction of wax to changes in temperature never quite equals the original increment of length changes, which fact should be remembered in protecting the pattern until ready to be cast.

Note please that in the advertisement quoted, it specifies: "Invest in ice water . . . tap water," etc.

Again quoting from the Taylor-Paffenbarger article[3]:

In the water bath method as outlined by Furrow, no mention is made as to what temperature the wax is when it is in adaptation to the die or cavity. Obviously, we cannot start to expand from any one of many temperatures and expect to get the same results.

Quoting Dr. Souder[5]:

3. Taylor, N. O., and Paffenbarger, G. C.: Survey of Current Inlay Casting Technics, J. A. D. A., 17:2058 (Nov.) 1930.

4. Rice, W. S.: Dent. Cosmos, 71:960 (Oct.) 1929.

5. Souder, Wilmer: Disc. of Van Horn, C. S.: Expanded Pattern Casting Technic, J. A. D. A., 17:763 (May) 1930.

I wish to read a part of a paper which was read in Chicago in March, dealing with the "Discovery of Expanded Pattern Technic": In order that there may be no misunderstanding or conclusion that I claim credit for the original technic of casting to dimension by the expanded pattern technic, I wish to quote from Van Horn (*Dental Cosmos*, Vol. 52, 1910, page 877), where he describes a method of casting which gives a result larger than the original wax pattern: "The investment was mixed with water at 120 F. The flask was heated in the machine so that when the investment was poured in the flask, the latter was very uncomfortably hot to handle with the fingers. The flask was at no time permitted to cool, but kept in a constantly increasing temperature until the cast was made, at which time it was at full red heat." From this experiment, he secured a net expansion of 1 per cent from pattern to casting. This reference also contains a quotation from Dr. Lane (*Dental Digest*, July, 1909, page 498) in which he establishes the importance of casting into hot flasks when shrinkage of gold is to be reduced or partially compensated. In 1911 (*Dental Cosmos*, Vol. 53, page 113), Van Horn added a further modification for accuracy in casting by investing with a slow setting investment and placing the flask in a water bath at 110 F., and as he states, "The flask with its invested pattern is to remain in the water bath—no water coming in contact with the investment —without any change in temperature until the investment has thoroughly hardened, which takes about one-half hour." That technic is being revived, apparently, by those who have not yet discovered this article, which is 18 or 20 years old. It does us no harm to give credit where credit belongs. I am pleased to include this in a part of the discussion, giving these two methods of (*a*) using hot water to mix the investment and (*b*) mixing the investment and putting in some kind of bath which will bring it up and expand the pattern before the plaster has set. . . .

It is not necessary to discuss the question which arises between our work and that of Dr. Van Horn, namely, that you may or may not be able to chill a wax in the tooth cavity. We did chill the wax on the steel mold that we were using. There are some people who feel that you can chill the wax in the tooth cavity to a certain extent and have it under pressure and have the wax fit the tooth at a lower temperature.

My reply was:

As regards chilling the wax pattern when in the tooth cavity in the mouth: It would require elaborate preparation; it cannot be done by merely spraying with cold water. In some of my former papers, two special thermometers are shown which I had made to determine the temperature of the wax pattern in the tooth cavity. During that series, I tried to chill the wax by the ordinary methods. There may be a drop of two degrees Fahrenheit, or perhaps a drop of 5 degrees, but before we can get the pattern out of the cavity, the temperature is again 95 F. My experience indicates that it is neither practical nor essential to attempt to chill the pattern *in situ*.

This contention is substantiated by Taylor and Paffenbarger,[3] as follows:

The author [in this instance, R. H. Volland] says: "The wax must be in adaptation with cavity details at a temperature closely approximating that of the room." In contrast to this statement, we find that Dr. Van Horn says that, in considering wax pattern temperatures in the mouth, we should consider mouth temperature or near mouth temperature as the temperature at which the wax will be in adaptation to the cavity details.

An experiment was performed to determine the temperature of wax patterns in the tooth *in situ* under varying conditions.

A cavity 4.8 mm. deep and 5.3 by 6.5 mm. on the occlusal surface was prepared in a lower first molar. A wax pattern with a thermocouple embedded in it was made on an indirect amalgam model and transferred to the dry cavity and sealed (Fig. 4). It rapidly assumed a temperature near to that of the body, 36.63 C. (98 F., approximately). Room temperature water, 26 C. (78.8 F.), was used to cool the pattern. After the pattern had been bathed for three minutes, the temperature of the pattern had dropped only 4 degrees C. (7.2 F.) to 32.85 C. (91 F.). Tap water which was at 18 C. (64.4 F.) was next used. After eight minutes, the temperature of the wax fell to 30.96 C. (87.9 F.). Ice water at 0 C. (32 F.) had to be resorted to in order to bring the pattern to 24.74 C. (77 F.) or just 2 degrees below room temperature, and under those conditions the patient

was far from comfortable. The pattern rapidly assumed mouth temperature after the supply of cooling water was cut off.

This experiment was carried out under the same conditions that prevail in actual dental practice. It was carried out in summer when room temperature was 26 C. (78.8 F.). From it, we can see that it is impractical to get the wax pattern in adaptation to cavity detail at room temperature. What if the experiment had been carried out during the winter months with room temperature at 20 C. (68 F.)?

In this "Survey of Current Inlay Casting Technics" by Taylor and Paffenbarger, there is embodied, I believe, a concise description of all of the widely heralded and prominently advertised technics to date, and it is a noteworthy fact that, in none of those technics, is tooth cavity temperature considered. In point of fact, not only is it ignored, but also the originators (?) of those multiple technics still insist either that "open mouth temperature is essentially room temperature," or if it is not, that it is a simple matter to fit the pattern at any room temperature to the margins of the cavity in the tooth *in situ* by spraying the wax with tap water.

The foregoing quotations and comments are intended to emphasize that:

1. Open mouth temperature is not room temperature unless room temperature happens to be at least 95 F.

2. Wax patterns cannot be fitted at room temperature to cavity details in a tooth *in situ*.

3. The Meyer-Maves, Whip-Mix and all analogous technics are, according to the Bureau's findings, based largely upon assumption and dependent on "a lucky and accidental combination of favorable conditions," to "produce an inlay which will be satisfactory," and even then "satisfactory" may possibly be based upon a false standard of perfection.

4. We must know and take full cognizance of the temperature of the wax pattern when it is fitted to the cavity margins in working either on a tooth *in situ*, or on a steel die or an indirect model in the laboratory.

5. The wax pattern must be invested at a known predetermined temperature which must be relatively constant, until the investment has thoroughly hardened, if we may hope to produce regularly uniformity in the correct dimensions of the investment molds in which inlay castings are subsequently made.

PATTERN WAX SELECTION

The only pattern wax suitable for work in the mouth is one which is nonplastic, i.e., a wax which is relatively rigid at tooth cavity temperature, and will, if sufficient force is applied, break with a clean fracture. Under no consideration should a wax be used which requires chilling below tooth cavity temperature in order that it shall become sufficiently rigid to admit removal from the cavity without distortion; which is very doubtful. An easy way to test wax is to place a piece in the mouth and to see if, after it assumes mouth temperature, it is easily bent, stretched or distorted; when it is not suitable for patterns.

After selecting a suitable wax, it must be softened prior to use. In this connection, I wish to again emphasize a point by quoting still another author, Robert P. Dressel[6]:

There are two methods of softening the wax to a working consistency; the use of dry heat (open flame) or the use of moist heat (water bath). The dry heat method, while not at all practical, is perhaps used by the majority of operators.

6. Dressel, R. P.: Dent. Cosmos, 71:942 (Sept.) 1930.

Wax softened over an open flame, unless the operator exercises extreme care, renders the wax almost unfit for further use. The outside surface melts quite readily; the wax just inside of that is soft, while the inner core of the wax is still hard.

I here assert that, relatively, that is exactly the condition of the wax desired and the most favorable to perfect adaptation. "Wax loses its working properties once it has been melted." I ask, why is this so? and how could pattern wax be compounded and marketed if it were not melted and molded into cones, sticks, etc.? "By the time the inner core of the wax has been sufficiently softened to be workable, the outside has been completely melted and, upon cooling slightly, flakes very easily." Personal experience with several pattern waxes on the market leads me to assume that suitable waxes, properly manipulated, do not so behave, i.e., "flake very easily."

CAVITY CLASSIFICATION

It is seemingly unnecessary to go into specific cavity classification in considering wax pattern making. I shall therefore divide all cavities into simple and complicated, leaving it with the individual operator to decide where simple cavities end and complications begin, and to govern his treatment in accordance with the specific wax manipulation indicated; the broad underlying principle in all wax pattern making for cast gold inlays being that the wax shall be condensed, without stretching, into the cavity; and if stretching does occur, it must be neutralized prior to removing the finished pattern from the tooth cavity.

All cavities must be scrupulously clean and moist. My contention is that, as a lubricant, the saliva is not only adequate but also preferable to any oil or grease of either vegetable or mineral origin. It seems rather far-fetched to consider variations in the thickness of saliva films that lubricate the cavities in the teeth in the mouths of our various patients; and as to pulp infection, the generally accepted practice in all work is, before forcing anything into a tooth cavity, to protect the sterilized cavity with a coating of varnish or cement or both.

Simple Cavities.—Simple cavities are rather easily managed. A piece of suitable pattern wax of appropriate size and shape is mounted on a carrier and warmed rather slightly over an open flame. The part representing the cavity is dipped into melted wax, immediately transferred to the moist cavity and, with gradually increasing pressure, pressed slowly and firmly to position.

In this type of pattern, the wax should be in the condition previously described and commented on: The part representing the cavity, being melted, offers no resistance, while the part immediately adjacent is considerably resistant, and the still harder part following, acting as a pressing plate, insures maximum sharpness in cavity details with the minimum liability to induce elastic stresses in the wax. Observe that any melted wax which is squeezed out is not stretched: One cannot stretch or bend melted or very soft wax: in a nonresistant state *per se*, it is not susceptible to elastic stress, nor is this state conducive, unassisted, to compression sharpness in cavity details; points worthy of recording and duly incorporating in wax manipulative procedure throughout.

In cavities involving occlusion, the teeth are brought gently into occlusion and with increasing pressure, just prior to the wax becoming hard, and are held firmly in that fixed position until the wax assumes mouth temperature, no masticatory movement being permitted during the interval. The wax is then carved

and finished perfectly as to margins, and correct occlusion established.

As complications in cavities arise, it becomes necessary to meet them by various means or by modifications in technic. A matrix may possibly be indicated in some cases, but I am rather opposed, on general principles, and in the case of certain types of band matrices, for specific reasons, to the use of a matrix, believing that better results can be so obtained, and more easily by the wax tray method.

Generally speaking, I favor the wax tray method for the majority of cavities as it seems to be not only the most simple but also the most logical procedure extant. It is believed that mastery of this rather simple technic will result in better fitting inlays, and add to the serenity of the operator as to the relative perfection of the marginal adaptation and continuity of the subsequent casting, especially at the cervical margin.

WAX TRAY; LIQUID WAX PROCESS

The technic to be here described was presented in 1912,[7] and, with minor changes, has been used continuously in my inlay work. I advised using wax forms; and a matrix for certain cavities[7] (*Dental Cosmos,* September, 1912, Figs. 1 to 7, pp. 975-978), both having been discontinued.

A piece of nonplastic pattern wax of sufficient size to give ample surplus is warmed over an open flame to a state of working plasticity admitting it to be readily pressed into the cavity and easily molded over the margins; the teeth are occluded as previously described, and the rough surplus only is carved away. No special attention need be paid to whether or not this wax is stretched or bent during this first operation; for, after any undesirable surplus is cut away, the mass is removed from the tooth cavity and placed in a water bath at a temperature of from 125 to 130 F. (modified to meet wax characteristics), which neutralizes any induced elasticity. It is then cooled, washed in alcohol, if necessary, to remove blood, etc., and we now have what I have characterized as a wax tray, a more or less perfect impression of the tooth cavity and immediately surrounding tooth tissue, together with the "bite" and contact surface of the approximating tooth recorded. The wax tray, being clean and dry, is examined as to marginal perfection and, after any required trimming is done, the cavity surface is coated with liquid (melted) wax, painted on with a No. 2 badger hair (porcelain) brush, the painting being done as indicated by the perfection of the markings left by the cavity in the wax tray. To illustrate: Assuming that the wax tray does not show a demarcation of the cervical margin of the cavity (Fig. 3, No. 1; *Dental Cosmos,* September, 1912, p. 976), but is apparently perfect in other details, we know that a greater bulk of wax is needed at that point than at any other; therefore, the wax tray is coated accordingly. (Fig. 3, No. 2.) As soon as the wax tray is properly coated, it is carried to the moist cavity, and carefully but firmly pressed home, carved as desired and removed.

It is not imperative, but in most cases is an advantage, to use a coating wax which has a lower fusing point than the wax used for the tray. It must be kept clearly in mind that the coating wax (which becomes an integral part of the pattern) must be sufficiently rigid not to become distorted when being removed from the cavity or dull when being expanded in the warm investment.

7. Van Horn, C. S.: Dent. Cosmos, 54:973 (Sept.) 1912.

SUPERIOR FEATURES

With the wax tray method, we eliminate the elastic property in stretched wax. Complicated cavities are rather easily managed, and, most important of all, the resultant pattern is, seemingly, the most nearly perfect that can be made.

Consider, briefly, the physical behavior of pattern wax and the conditions under which it is manipulated in a tooth cavity in the mouth. Pattern wax expands or contracts under varying thermal influence: According to the Bureau, the "length change is approximately 0.07 per cent a degree centigrade or 0.04 per cent a degree Fahrenheit"; tooth cavity temperature is relatively fixed, approximately 95 F.; room temperature, let us assume for illustrative purposes, is 75 F.; and let us again assume that the wax we are using ceases to flow, under the pressure used to force it into the cavity, at 105 F. The wax under consideration contracts approximately 0.3 per cent for each 10 degrees Fahrenheit. We therefore have a theoretical discrepancy in the pattern of approximately 0.3 per cent, which is due to that percentage of shrinkage between 105 F., the temperature at which the wax ceases to flow, and 95 F., the approximate temperature of the wax when being fitted to the cavity; it, of course, being clearly understood that wax cannot be added where most needed, the cervical margin, with the pattern in position in the tooth cavity in the mouth.

With the wax tray method, we establish a tendency to reverse the behavior of the wax. Again assuming the wax tray is at 75 F., room temperature, it is quickly coated, on the cavity surface, with melted wax and immediately forced into the cavity, which is at approximately 95 F. Hence, the tendency of this wax mass is to expand rather than contract. In some cases and during the high room temperature period, it is advisable to chill the wax tray in some manner, as by placing it on a bottle filled with cold water.

REMOVING FROM CAVITY AND CARVING

Before removal from the cavity, the pattern must be finished as well as possible at the margins and occlusion landmarks definitely established. A No. 6 explorer is embedded, cold, in the pattern at a logical point, and the pattern gently lifted out. Embedding hot sprues or thrusting hot instruments into the pattern *in situ* "to relieve wax strains" is contraindicated. In neither instance is the desired result certain. Patterns may easily be distorted (bent) by the hot sprue, and wax strains induced, rather than released, by hot instruments thrust into it.

The pattern is then mounted on the sprue wire by sufficient heating of the head to melt the wax at the point of contact so that it may easily be embedded securely in the pattern, it being obvious that no thermal distortions can occur nor elastic strains be induced through this procedure. Sprues should be round, of solid wire, not tubing, 13 gage (0.072 inch), at least 1 inch in length. The head or embedding end, filed flat (or square), holds the pattern securely against rotating on the sprue wire while the necessary carving is done on the cavity surface and the usual touching-up is given after removal from the tooth cavity.

Except for the cervical aspect, the entire cavity surface of the pattern should be reduced by scraping and carving to within 2 mm. or more from the margins, which reduces the bearing surface and incidentally makes room for a stronger layer of cement, the contention being that it is next to impossible, generally speaking, to make the interior (dentin) surface of the cavity in the tooth in the mouth sufficiently smooth (mechanically) and

even to admit of a well-fitting inlay's being seated when consideration is given the fact that castings do not come from the mold with the same surface smoothness and characteristics as the wax. It should be clearly understood that this minute invisible cavity surface roughness or unevenness does not prevent the withdrawal of the wax pattern from the cavity; nor does it contemplate nodules on the casting, which result from air being trapped in the coating of the pattern, and which are readily observed by "binocular loupes" or other simple devices, which should always be employed to examine both the wax pattern and the casting.

LABORATORY CARVING AND FINISHING

Facility and accuracy in carving wax to represent tooth form predicates: (1) knowledge of tooth form; (2) acquired dexterity, and (3) properly designed carving instruments.

We not infrequently hear a dentist say: "The main reason that I use the impression-model method is that I cannot successfully carve a wax pattern in the mouth." My reply is: Why then do the carving in the mouth? The only really necessary carving in the mouth has as its object perfectly finished margins and the establishing of well-defined occlusion landmarks. It is not essential that the contact point be established while the pattern is *in situ,* as this can be done more easily, and seemingly as accurately, in the laboratory.

Contrary to prevalent assumption, any suitable pattern wax may be added, when melted, to itself, or to any other pattern wax, when cold. The union (fused) between the melted and the cold wax will be perfect and, with a proper applicator, the melted wax can easily be placed where desired and in quantities required without encroaching on the margins of the pattern, it, of course, being obvious that melted wax dare not be added to the margins nor to sections so thin that the cold wax section would be fused by contact with the hot wax.

After the cavity surface of the pattern is carved as required and desired, attention is directed to the occlusal and approximal aspects.

With a properly designed instrument, it is not at all difficult to carve out the sulci, intensify cusps, correct planes, blend contour, etc., thus adding to the pattern what seemingly is so dear to the heart of the "indirectionist," the artistic touch; and the finished pattern will require no polishing, the surface left by the carving instrument being adequately smooth and even to insure a casting which requires only the customary polishing after cementing. I find that binocular loupes, properly adjusted, greatly facilitate and expedite inlay work both in and out of the mouth, including cavity preparation.

THE CONTACT POINT

It is my opinion that the contact point can be more easily and just as accurately formed on the wax pattern after it is removed from the cavity. In my practice, no special attempt is made to form the contact point on the wax *in situ.* In fact, no special attention is given to accuracy in approximal contour, which may, if you please, be flat rather than convex, the procedure being as follows: The pattern must be finished as well as possible at all margins while *in situ,* which means that there will be a finished portion or surface or band all around the periphery of the pattern, this finished peripheral band being at least one-sixteenth inch in width, and the marginal ridge defined. The sprue wire has been placed occlusally to the contact point location. Any de-

ficiency in the circumscribed approximal area is then built by adding melted wax where required and as desired. It is usually preferable to exaggerate the contour slightly. The added wax is then carved as desired and as required by the definitely established occlusal, buccolingual approximal and cervical landmarks, as previously described.

INVESTING THE WAX PATTERN

Here again, the literature reveals much ado over a rather simple operation, coating the wax pattern. It is not within the province of this paper to consider kinds of investment, the folly of mechanical mixers of the "egg-beater" variety, the unnecessary task of making a putty-like mix or the seeming absurdity of endeavoring to vibrate the putty-mix to place, etc. Therefore, the sprue wire, with attached pattern, having been fixed in position in the crucible former, the pattern is coated by the application of the regularly mixed investment with a suitable (small cement) spatula, rather than a brush, to a prominent part of the pattern and gently forcing it to place, care being observed not to entrap any air, particularly on the critical parts of the cavity surface. The entire pattern having been coated to the desired thickness, the excess water is absorbed by dusting the coating with dry investment powder and applying absorbent paper to the dusted surface. R. E. Denney, in discussing a paper of mine,[8] was, I believe, the first to call attention to excess water collecting on the surface of the wax pattern as a cause for casting surface roughness and suggesting the absorbent paper remedy.[9]

If, in coating the pattern, a stiffer or a "putty-like" mix is desired, as is often the case, it is easily and quickly obtained by placing a suitable bit of the regular mix on a piece of absorbent paper, picking suitable portions of this dryer investment off the paper with the spatula, placing it where desired and gently pressing—not vibrating—it to place.

The pattern being coated as desired, the flask is placed in position on the crucible former, and filled with the regular mix without vibrating. It is then transferred to the investing standardizer, the temperature of which must be predetermined and relatively constant until the investment has thoroughly hardened, which should take about one-half hour. Remember that the relative size of the mold is dependent on the temperature of the wax pattern at the time the investment hardens, and that an interval of time is essential to bring the wax up to the required temperature and concurrent desired expansion after the flask is placed in the investing standardizer. Furthermore, while pattern wax has a definite reaction to thermal change, the expansion seems to be rather sluggish; hence, a slow setting investment is imperative. I wish here to point out that in contradistinction to those devices known as wax expanders, etc., an investing standardizer is what its name implies: an appliance which controls and maintains, relatively, any definite predetermined temperature in the wax pattern before and during the critical setting and hardening periods of any suitable investment.

Just one more thought which, perhaps, has not herein been stressed sufficiently. Generally, I can see no logical reason for the impression model method for wax pattern making, but rather can see much against it. In those rarely few instances

8. Denney, R. E.: Dent. Cosmos, 61:193 (March) 1919.

9. Research Paper No. 32, 1928 (R. L. Coleman).

in which the indirect method might possibly seem advantageous, these points should be observed:

1. It is more impractical to endeavor to chill an impression of a tooth cavity in the mouth than it is a wax pattern.

2. Present impression compounds expand and contract similarly to pattern waxes, length change being somewhat less in the compounds.

3. The relative dimensions of model to cavity are therefore in the same ratio as approximately 95 F. and the room temperature at which the model is made.

4. The wax pattern being fitted to cavity details of this indefinite model in the laboratory at, presumably, whatever temperature the room happens to be, it is manifestly obvious that cognizance must be taken of: (*a*) length change in the cavity impression, and (*b*) the temperature at which the pattern is fitted in order to arrive at the temperature at which the pattern must be invested.

The questionable practice of endeavoring to fit the inlay to the tooth cavity margins *in situ* by burnishing or spinning the gold to the cavity margins of a model of indefinite relative dimensions is, of course, not within the scope of this paper.

WAX ELIMINATION

Since all research to date decrees that the casting shall be done in a hot mold (1,100 F. or a higher temperature), wax elimination by carbonization seems the most simple method. It may be done by placing the invested pattern in any convenient water container and boiling the wax out gently. Drs. Taylor and Paffenbarger describe the process most satisfactorily in an outline of the Meyer-Maves technic:

> The wax is eliminated by placing the ring in a special boiler which has a water compartment and a sealed off space for the ring so that steam and water can boil through the investment, carrying the wax out, but no better results are obtained than by the carbonization method. It is a superfluous step—entirely unnecessary—but appears to be harmless.

RÉSUMÉ

1 Casting to dimensions not only implies but also demands (*a*) accurate knowledge and definite data on the physical behavior of all materials entering the process, and (*b*) cognizance of the temperature at which the wax is fitted: to the cavity *in situ*, to an indirect model cavity or to a steel die in the laboratory, the operator keeping in mind the fact that minimum tooth cavity temperature is 95 F. and that room temperature varies from, say, 70 to 90 F.

2. The only effective wax expansion is that which occurs between the temperature at which the wax is fitted to the cavity and the temperature at which it is invested. Hence, laboratory experiments or technics are not necessarily a reliable index to proper procedure in restoring lost tooth structure to teeth in the mouth.

3. Patterns made perfectly in cavities in indirect models may be distorted: (*a*) by reason of thermal length change in the impression compound and (*b*) by mechanical inaccuracy in detail, by reason, more especially perhaps, of the impression's being moved (rocked, tipped, etc.) in being taken.

4. We must recognize and eliminate elastic stresses, remembering that maximum expansion *per se*, in properly manipulated pattern wax of suitable quality, is up to any temperature at which the indicated wax will not be distorted or dulled by reason of its inherent plasticity under given thermal influence.

5. Wax expansion and investment expansion must, either singly or in com-

bination, coordinate with gold shrinkage. Therefore, we must, in each instance, know the respective temperatures. To illustrate: Assuming that we have a suitable investment which has an expansion greater than 1.25 per cent, as is mentioned by Taylor and Paffenbarger, the investment expansion (alone) would therefore neutralize a like contraction (1.25 per cent) in the gold. Hence, if the pattern is made direct, it must be invested at 95 F., approximately. If it is made indirectly, it must be invested at whatever room temperature it is made plus a compensation temperature to neutralize the length change in the impression compound. The investment mold is then brought up to the temperature at which it expands 1.25 per cent, and the cast made without any lowering of mold temperature.

Taylor and his associates[10] describe the investment referred to under "sample 34," composition, 24.5 per cent plaster, 75 per cent cristobalite. When it is mixed with 0.42 per cent water, the initial setting time is five minutes and final setting time, seventeen minutes. Thermal expansion is 1.18 per cent at 600 C. (1,112 F.) up to 1.27 per cent at 700 C. (1,292 F.). In a footnote to page 2275,[10] we find:

> 2. Mix enough investment to fill one ring. Use 40 c.c. of water to 100 gm. of investment. . . . Be prepared to use it immediately as the setting time is short. Have all materials at room temperature. 3. Paint a pattern with the mix. Take as large a portion of investment as possible on the brush and flow it on the pattern. Cover the pattern rapidly, place it in the ring and pour the remaining investment around the pattern. . . .

In an article, "Standardizing the Investing Process and Simplifying the Casting Process,"[11] published in 1911, I endeavored to call attention to what standardization implies and the importance of its recognition in the investing process. Standardization never has implied that the wax pattern *per se* must be expanded, but it does imply that, with all waxes and investments to date, the pattern must be invested at a predetermined temperature, and that the temperature must, in effect, be constant throughout; which further implies that the investing material must have an initial plastic period or state of sufficient duration to admit of any necessary wax adjustment, or balancing. With present materials, casting to dimensions, by either the direct or the indirect technic, demands that zero dimension of the wax pattern or the compound impression be placed at tooth cavity temperature, zero dimension being the point from which length changes, plus or minus, are calculated.

Theoretical comment on investment "34" would, as far as the present paper is concerned, seem to embody the following considerations:

1. Any investment which requires haste in coating and investing the pattern is contraindicated. The larger and more complicated the pattern, the longer the time required to coat it, and, paradoxical though it may be, the more essential it is that such patterns be invested in a manner which insures the maximum in dimensional precision in the subsequent casting.

2. The pattern, having been fitted *in situ* at 95 F. (minimum temperature), is invested at room temperature, for illustrative purpose, let us say, at 70 F., a difference of 25 degrees F. Pattern wax, according to the Bureau's value, has a

10. Taylor, N. O.; Paffenbarger, G. C., and Sweeney, W. T.: Dental Inlay Casting Investments: Physical Properties and a Specification, J. A. D. A., 17:2266 (Dec.) 1930.

11. Van Horn, C. S.: Dent. Cosmos, 53:1109 (Oct.) 1911.

length change of approximately 0.04 per cent per degree F.; hence, a contraction of 1.00 per cent in the pattern (25x0.04% = 1.00%); the maximum thermal expansion of the investment is 1.27 per cent at 700 C. (1,292 F.); the gold contraction is 1.25 per cent, and we therefore have an investment expansion over gold contraction of 0.02 per cent; but when this 0.02 per cent investment plus is deducted from the 1.00 per cent wax minus, we have 0.98 per cent unneutralized. In other words, the casting, by reason of the wax pattern's not having been "expanded" the equivalent of 25 degrees F., will be too small by 0.98 per cent.

3. Ordinarily, this seemingly simple matter would be corrected by investing the pattern at 95 F., and casting at 550 C. (1,054 F.), this being the temperature at which the investment expands 1.25 per cent; but this is not feasible with an investment which sets so quickly. For many years, I have been endeavoring to emphasize that a slow setting investment is imperative when casting to dimensions is essential.

My present thought is that investments of the type specified may possibly be of some value in the indirect technic if it can be used as the cavity model into which the wax pattern is fitted and the casting made, but will be worthless in considering pattern waxes and their manipulation in tooth cavities in the mouth. It should not be overlooked that, incidentally, it might be of considerable aid, in evaluating descriptive technics, to remember that an author is not necessarily an authority, nor are clinic or laboratory demonstrations always based on accurate data.

We read[3] that:

Thousands of dollars have been spent by the dental profession on special clinic and lecture courses which are presented by clinicians and lecturers advocating empiric and arbitrary methods without sound scientific foundation, not always because they are interested in progress, but often because they are interested primarily in selling special materials, equipment or service. . . . Certain groups seem to have fallen into this type of propaganda, and whether intentional or not, the exploitation of the profession is evident. Dentists must cease to be victims of sales propaganda if they are to be true to their profession.

I have endeavored in this paper to stimulate constructive thought along rational lines that logical deductions may obtain. Seemingly, the profession has been remiss in evaluating casting materials, technics and appliances. This does not imply that we must be experts in physics, metallurgy and other allied subjects, but does presume that we have sufficient knowledge to differentiate between honest endeavor, ethical achievement and crass commercialism. Dr. Souder's solution to the problem is, "a familiarity with the laws governing dental materials, for honesty and completeness in the interpretation and display for experimental work, for technics based on accurate data and a selection of materials yielding most in the scope of desirable qualities," which implies that consummation and facility in application require ethical cooperation within the profession and with and by the dental manufacturer.

A treatise on pattern waxes and their manipulation would be incomplete without reference to William H. Taggart, who made possible maximum efficiency in the expanded pattern casting technic by introducing a nonplastic pattern wax; and it may be of interest, to you men in Chicago especially, to know that, in my judgment, Dr. Taggart's original "green wax" has not been excelled, if equaled, in "yielding most in the scope of desirable qualities."

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TREATMENT OF VINCENT'S INFECTION

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IN reviewing the literature on the treatment of Vincent's infection, one is struck with the diversity of the methods used. Approximately forty different drugs and chemicals, either alone or in combination, have been advocated in the treatment of the disease. Many have claimed specific properties for their individual treatments and have had their claims disputed almost as soon as they were published. I do not intend to promote further controversy on the subject. I have attempted to analyze the subject from an angle which is probably different from that of most other writers and have based my findings upon a review of the various treatments, coupled with a large clinical experience.

In the treatment of infections of the oral mucous membranes, there are many factors which must be considered. Unlike many areas of the body, the organs and tissues contained within the oral cavity must function continually, notwithstanding the infection. It is extremely important that the medicaments used shall not have a harmful action on the enamel of the teeth, either through actual destruction of the enamel or even through a superficial etching. An etching effect, though not marked clinically, will predispose to caries by offering a roughened surface for the attachment of bacterial plaques. We must also consider the effect of our treatment on the mucous membranes. Anything used in the treatment of mouth conditions which will tend to destroy or pervert the function of hard or soft tissue must, necessarily, be subjected to thoughtful scrutiny. Our next consideration in selecting our treatment is the organism or organisms to be dealt with. We must consider their virulence, their characteristics as to growth, their ability to assume spore forms, their ability to penetrate the tissues and their resistance to any single form of treatment. We must also consider the reaction of the patient toward the form of treatment used. It must be reasonably pleasant to him.

The causative organisms of the disease are low-grade in character. They have saprophytic tendencies and are anaerobic. This leads us to believe that medicaments strong enough to affect either the teeth or the tissues need not be used. It also suggests that oxygen-yielding compounds should be valuable in combating the organisms. The disease is local in character and, therefore, local treatment rather than systemic treatment seems to be indicated. If there is any systemic condition which has predisposed the tissues to pathologic processes or which is concurrent with the disease, we must, of course, institute general as well as local therapy. In some cases, we have noted that, after a certain treatment has been used over a period of time, the organisms seem to become resistant to it. Whether this is due to some underlying etiologic factor or to the fact that the organisms build up a form of acquired immunity to the

treatment, we do not know. Our observations lead us to believe that the latter is the case, because a change in treatment will clear up most of these cases. We have noted, as stated before, that, in treated cases, the borrelia tends to take on a beaded appearance and the fusiform organism becomes larger, staining very lightly and displaying chromatic granules.

Sodium perborate as an oxidizing agent for the treatment of Vincent's infection was first advocated by V. E. Meigeville, of Paris, in 1905. When sodium perborate is brought in contact with water, oxygen is given off to the extent of from 7 to 9 per cent. (All the oxygen is not liberated except in the presence of acids.) Patients must be warned to obtain it in the original package as oftentimes sodium bicarbonate is substituted for it. Sodium bicarbonate, while useful, does not equal the perborate in efficacy as it yields only from about 1.5 to 2 per cent of oxygen. Hydrogen peroxid is a valuable adjunct, but the use of strong solutions over any length of time seems to have a detrimental effect on the tissues. Potassium permanganate and potassium chlorate are both of value.

We believe the use of acids or caustics to be contraindicated. For a period of years, we used chromic acid, but have discontinued this procedure, as we found, on experimentation, that the chemical effect of the acid on enamel was harmful. This action was confirmed both chemically and clinically. We do not believe that the use of chromium trioxid in combination with hydrogen peroxid is indicated. The hydrogen peroxid, when in contact with chromium trioxid, gives a solution of chromic acid. Chromic acid in the presence of an excess of hydrogen peroxid forms perchromic acid and oxygen, and further breaking down results in the formation of inert compounds. The use of silver nitrate, alone or in combination with chemical reagents, such as iodin, we believe to be contraindicated. All of these medicaments will have a resistance-lowering effect on the soft tissues of the oral cavity. They tend to have a marked escharotic effect. If used in solutions which are at all strong or, if used too often, their effect is decidedly detrimental. Some of the other acids which have been used are nitric, sulphuric and trichloracetic. These all have properties which rule them out. Weak chromic acid is of value in a local process where it can be swabbed directly into the gangrenous lesion. Only a single application is necessary in many cases. It should be used only when it will not come in contact with the teeth.

Seven or eight years ago, we used some of the resorcinol compounds in the treatment of Vincent's infection but were unable to obtain favorable results. This was probably due to the fact that the methods of combination of the drug were unsatisfactory. The use of hexylresorcinol (S. T. 37), recently brought out, has apparently been very effective.

A few men have advocated the use of vaccine therapy. This was tried shortly after the War and, while we have not tried it in recent years, it is apparently ineffective. Vaccine cannot be made of the Vincent's organisms. If used, it must be made up from the secondary organisms which are present in the lesions. The literature seems to bear us out on this point.

Treatment of the infection with the various spirochetecides has taken a prominent place in the literature dealing with treatment of the disease. Arsphenamin was first used in 1912. Most writers seem to agree that local application of the drug is effective to a greater or lesser degree. There is much controversy on

the point of intravenous and intramuscular injection as a means of treating the disease. We have found that, properly applied, it is one of the best means of local treatment. Its action is rapid, and acute local symptoms are quickly reduced with it. We have found that the most significant thing with this drug is the tendency of the disease to recur after apparent cure has been effected. This, we believe, can be explained by the fact that granulation occurs very rapidly. If the arsphenamin is not introduced to the depths of the lesion, there will be a surface healing with the formation of pockets. These pockets will form a focus from which the disease will flare up whenever the resistance of the individual is momentarily lowered. It seems to us that its failure lies with faulty manipulation on the operator's part rather than with the medicament. In treating acute cases in which pocket formation has progressed to a very limited extent, there does not seem to be the same tendency to recurrence. We believe that it is one of our most valuable agents if properly used, but we do not believe that it is a specific for the disease.

Arsphenamin has been widely used, through intravenous or intramuscular injections, in an attempt to control the lesions of Vincent's infection. It has been our experience that such application does not have any tangible results; in some cases, at least, it apparently aggravates the local condition. The lesions of the disease are local in character and such effect as is produced by a regular course of arsphenamin administration seems to be negligible. Arsphenamin may be especially toxic in a large dose in an individual with a markedly lowered resistance such as is produced by Vincent's infection. In many cases, we have advocated an injection of one dose of arsphenamin. This is not done with the hope that the local condition will be improved by the action of the drug. We believe that such a dose, in many cases, will act as a tonic and aid in building up the general resistance of the patient. For the same reason, we prescribe a saturated solution of potassium iodid—5 drops three times daily, for a period of about ten days.

We advocate the use of the ultraviolet ray in the treatment of the disease. The mercury arc lamps seem to be best suited for this treatment as they are powerful and seem to have a higher therapeutic value than the cheaper lamps. We do not believe that the ultraviolet rays are specific for the disease, but we do think that their use, wherever possible, will aid materially in clearing up stubborn cases. Systemic irradiation is indicated as well as local applications.

Dr. Gottlieb of Vienna advocates the use of the Dunlop method for pyorrhea treatment as effective in Vincent's infection. His reports are highly satisfactory, and if they continue to be substantiated, we feel that he has a treatment which is nearer a specific than any which have been brought forward to date. The Dunlop method consists of the use of a paraffin, a salve and gaseous oxygen. The tissues are aerated with oxygen which passes through a solution containing boric acid and another medicament made up of alcohol, oil of peppermint and another ingredient. Thereafter, the pockets are packed with a salve containing the same materials and covered up with a paraffin mixture. These treatments are given once each day.

In the general and home treatment of the disease, it is essential that the dentist have the entire cooperation of the patient. The patient must be impressed with the fact that he has a serious condition, and that the length of time necessary for

clearing up the disease will depend to a great extent on his faithful attention to instructions. A well-balanced diet is a prime requisite in building up the general resistance of the patient. Vitamin-containing foods and fruits are prescribed. Foods tending to produce acidosis are eliminated from the diet. Fatty foods, tomatoes and similar articles of diet come under this classification. Another important general factor is proper elimination. We have found that many of our cases show some degree of constipation: this, of course, predisposes the tissues to toxic changes and hinders the general raising of the resistance which is so necessary in properly combating the condition. Catharsis is prescribed in all cases. As routine home treatment, we advise the use of a good grade of castile soap, to be used in place of tooth powder or paste when the more acute symptoms have subsided. The patient is warned to use a soft brush and not to brush too vigorously. Reasoner and Gill, in 1927, pointed out the value of certain oils in soaps in the treatment of mouth infections. It may be of interest to note here that Dr. Robet, of France, did work along similar lines in 1905. For sprays and mouth washes to be used at home, we advise solutions of sodium perborate, 1 teaspoonful to three-quarters of a glass of warm water, every two to three hours. Hydrogen peroxid, one-third strength, may be used. Any of the ordinary mouth washes may be used, but we have found that most patients tend to use them too often or in solutions which are too strong. We advise against the use of any strong astringent in the treatment of the disease and feel that the detrimental effects of such agents will overbalance their good qualities. A review of the literature on the effect of strong astringents on the mucous membrane will fully bear this out. Glycogenic infiltration and mucoid degeneration of the mucous membrane will follow continued use of such astringents. On cessation of treatment, the patient is warned to burn his old toothbrush, as many cases of reinfection have been traced to continued use of the brush after the disease has been cured.

This article on the treatment of Vincent's infection is not intended to influence, in any way, the mode of treatment used by any particular man or group of men. We have simply taken the various methods which have proved more valuable and attempted to evaluate their efficacy from a physiologic as well as a therapeutic standpoint. Needless to say, we have been forced to leave out many forms of treatment. We believe that those considered above may be classified as the standard forms of treatment at the present time.

Our conclusion from this review of the literature and from our own personal observation is that there is no single specific for the disease. We believe that the disease can and should be treated by methods which do not produce harmful effects on the hard and soft tissues of the oral cavity.

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THE REACTION OF CEMENTUM IN THE PRESENCE OF INJURY AND INFECTION*

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THE importance of the cementum has come to be recognized more fully in the research of recent years. The biologic activity of the cementum has been studied in sections made of the tooth in its position in the surrounding tissues. Covering the entire root surface, the cementum serves as a connecting medium for the fibers of the periodontal membrane with the dentin body of the root. Even at the apical foramen through which the pulp communicates with the organism, no exception is found to this fact, as the outer part of the foramen itself is formed by cementum deposited around the entering blood vessels and nerves. Comparative studies of the roots of young and old individuals have given positive evidence of the continuous increase in thickness of the cementum deposited in successive layers one upon the other during the life cycle of the tooth. The roots of the teeth of old individuals generally show many layers of cementum laid down in thin lamellae parallel to the root surface.

From a biologic standpoint, this continuous deposit of cementum must be considered as a process to insure a root surface of high vitality. The cementum is a bonelike substance that is not physiologically resorbed. The basic difference between bone and cementum is that bone is continuously resorbed and rebuilt without much change in its total amount. Cementum, instead of being resorbed and replaced, is simply continuously covered over with new layers and increases in thickness with each new deposit. In this way, a newly formed surface of high vitality is always present, providing a continuous, firm attachment for the fiber bundles of the periodontal membrane. Were it not for this important characteristic of the cementum, there would be no means of repairing injuries of the roots of teeth. Since all soft tissues are continually being worn out and replaced, new fibers of the periodontal membrane could not become attached to the root surface were it not that new cementum deposits were continuously being laid down on the root.

In the light of these facts, it evident that resorption of the cementum indicates the presence of a pathologic process and shows that damage has occurred from some physical, chemical or bacterial condition present. When the living connection, that is, the attachment of the fibers of the periodontal membrane, is destroyed by resorption of the cementum, the support of the root is lost in proportion to the extent of the damaged area. Therefore, when the fibers of connective tissue which support the tooth

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*From the Research Department (Director, Rudolf Kronfeld) of the Chicago College of Dental Surgery, Dental Department of Loyola University.

in its socket become detached from a sufficient amount of root surface, the root is loosened in its socket. Fortunately for the life of the tooth, the defensive mechanism of the body not only organizes to offset the injury but also is able to check the resorption and to institute repair by means of rebuilding or replacing the lost tissues. New cementoblasts appear and the resorbed area is covered over with a deposit of new cementum to which new fibers of periodontal membrane become attached. In this way, the area is repaired and restored to function.

In the examination of much material, there is histologic evidence of resorption and repair often extending beyond the cementum into the dentin. This evidence points to a pathologic process that was

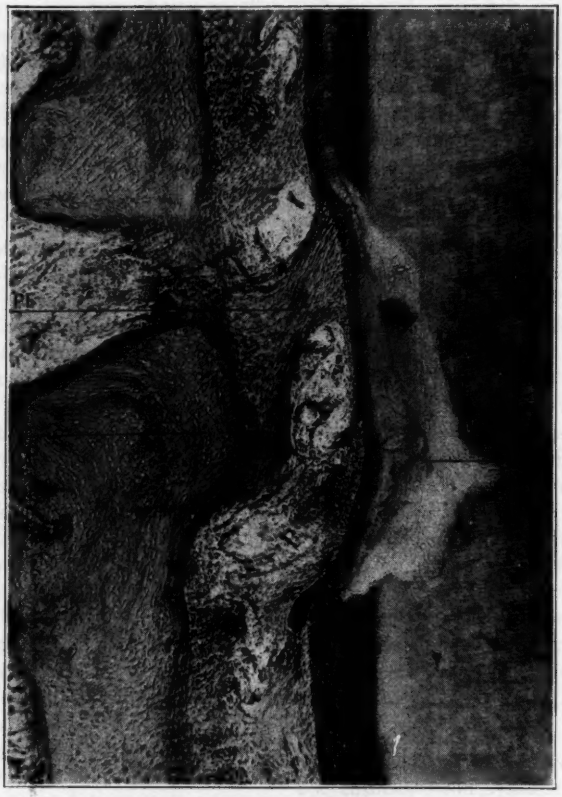

Fig. 1.—Reparative process following resorption in the cementum and dentin. *R,* border of resorbed area; *C,* new cementum; *PF,* new periodontal fibers; *AB,* alveolar bone built out to restore a normal width of periodontal space.

once present and was overcome, the tooth being restored to normal function again. The control of this reparative process is one of the mysteries of biologic forces contained within living organisms. repair might be of considerable help in treatment if we could thus be enabled to engage these natural forces in cooperation with our therapy.

Influences which might interfere with

Fig. 2.—Fragment of cementum *(C)* torn away from surface of a root. This area is repaired by new deposits of cementum *(C)*. *AB*, alveolar bone. *PF*, original periodontal fibers. *NF*, new periodontal fibers extending between new cementum of root and new layers of cementum deposited on surface of fragment. (W. A. Figg.)

The knowledge of the process by which the organism mobilizes these forces of the normal physiology of the cementum may be grouped under the following

headings: 1. Functional trauma; fracture; resorption without external cause (diffuse atrophy). 2. Removal of the living pulp from the tooth. 3. Inflammatory reactions associated with pulp decomposition. 4. Marginal inflammation and defensive reactions against epithelial proliferation along the surface of the root.

It is the purpose of this paper to deal mostly with changes which occur in the cementum, accompanying or following the loss of the pulp. It seems a logical deduction that the reaction of the cementum to invasion of bacteria through the numerous foramina in the root apex should have a close relation to the reaction of the same substance to the invasion of bacteria in the gingival crevice. Furthermore, if new layers of cementum deposited on the root surface limit the progress of approaching epithelium which is proliferating in or around a cyst or an apical granuloma, should not the same tissue limit the downward growth of the epithelium of the gingival crevice? Epithelial growth along the tooth surface is a physiologic process under certain conditions, but becomes pathologic in character when accompanied by an inflammation in the periodontal tissues.

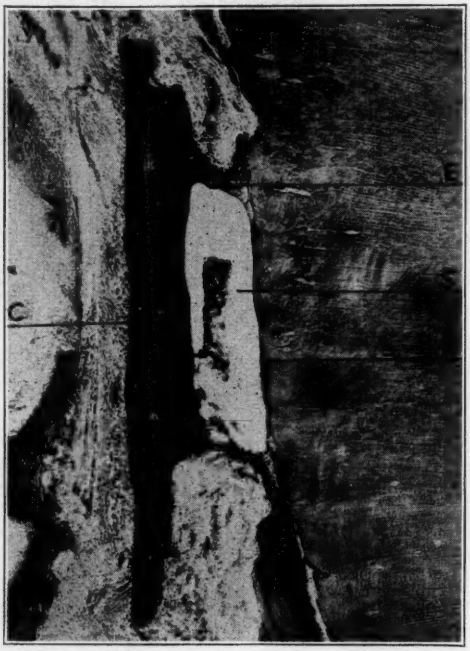

Fig. 3.—Fragment of cementum *(C)* torn away from the surface of a root at *R*. No repair has taken place because growth of epithelium *(E)* between root and fragment has prevented normal repair process. *S*, space enclosed by surfaces of hard tissue and epithelium resembling a cyst cavity. (Georg Stein.)

The first illustrations deal with the reparative process following injuries of

traumatic origin. An excessive amount of occlusal stress may cause resorption of small areas in the root surface. In Figure 1, a case of this type is shown in which resorption took place earlier, extending through the primary cementum well into the dentin. The irregular border of the dentin is easily distinguished from the new layers of cementum that is seen bulging out from its normal outline to fit into the concavity where the repair is taking place. The width of the periodontal space has been made normal by this outgrowth of alveolar bone, so that the relation between bone and cementum is the same as before resorption took place. Possibly, this resorption is the result of overfunction causing an

Fig. 4.—Repair of accidental fracture of dog's tooth. *R*, root surface; *S*, splinter of dentin and cementum isolated between alveolar bone *(AB)* and root surface *(R)*; *PM*, periodontal membrane entirely surrounding splinter as well as forming attachment between root end and splinter on one side and between splinter and bone on other sides; *C*, cementum deposits covering splinter.

have repaired the injury. A well-defined bundle of fibers of the periodontal membrane extends from the new cementum to the alveolar bone. The alveolar bone injury to the tissue at this point, and later the overfunction was compensated by some relief which caused a discontinuance of resorption and instituted a repair

process. Gottlieb[1] and Orban[2] have shown cases of cement hyperplasia in tuberosities or spikelike projections without previous surface resorption as examples of the very favorable reaction of the tissue to unusual occlusal stress. Gottlieb claims that the end-result in abnormal occlusal stress depends on the capacity of the periodontal tissue to produce reparative cementum. Orban[3] shows cases of functional repair in which, after resorption of the root, cementum was deposited and new alveolar bone formed.

The reparative process following a

Fig. 5.—Beginning repair of crack in tooth root of dog referred to in Figure 4. *RS,* root surface. *CT,* connective tissue from periodontal membrane *(PM)* filling crack. *C,* new deposits of cementum begining repair which would eventually close the crack. *AB,* alveolar bone; *D,* dentin of root.

partial or total fracture of a root occurs in a corresponding manner. Figure 2 is a reproduction of Figure 1 from a paper by William A. Figg.[4] It shows a tear in

1. Gottlieb, Bernhard: Die diffuse Atrophie des Alveolarknochens, Ztschr. f. Stomatol., 1923, Vol. 21, No. 4; The Formation of the Pocket; Diffuse Atrophy of Alveolar Bone, J.A.D.A., 15:462 (March) 1928; Tissue Changes in Pyorrhea, J.A.D.A., 14:2178 (Dec.) 1927.

2. Orban, Balint: Dental Histology and Embryology, Ed. 2, Philadelphia: P. Blakiston's Son and Co., 1929.

3. Orban, Balint: Resorption and Repair on Surface of Root, J.A.D.A., 15:1768 (Sept.) 1928.

4. Figg, W. A.: Tear in the Cementum, J. Dent. Res., 8:623 (Dec.) 1928.

the cementum which separated a splinter from the surface of the root, but did not remove all the cementum except at one point. Resorption and repair by new layers of cementum can be seen on the root surface. The splinter shows new layers of cementum on both sides to which bundles of connective tissue are attached. The original fibers can be seen between the splinter and the alveolar bone, and new fibers have been established between the splinter and the root surface, which now has many new layers of cementum covering the place from which the splinter was detached. In a paper by Stein,[5] a similar splinter is shown (Fig. 3) separated from a root, but here no cementum repair took place. The splinter is attached to the cementum of the root *only at each end,* by connective tissue. Epithelium is growing along the fractured surface of the splinter and on the exposed dentin from which the splinter separated. This layer of epithelium, at each extremity of the fragment, prevents con-

Fig. 6.—Resorption associated with diffuse atrophy shown by Gottlieb. *R,* resorption in the apical region of an upper incisor; *PM,* abnormal periodontal tissue thickened so that tooth becomes elevated into abnormal occlusion (pathologic wandering).

5. Stein, Georg: Histologische Untersuchungen im Wurzelspitzengebiete pulpatoter Zähne, Ztschr. f. Stomatol., Vol. 27, No. 2.

nective tissue from surrounding the fragment and building cementum, as was seen in Figure 2. The epithelium in this case developed from epithelial rests that were, at the time of the fracture, lying in the periodontal membrane, and were stimulated to growth by the change in environment.

this type is shown in Figure 4. A fragment of the root of a dog's tooth is seen isolated between the body of the root and the alveolar bone. The fragment is entirely surrounded by new layers of cementum, which have been deposited on both the dentin and the old cementum of the fragment. A new periodontal

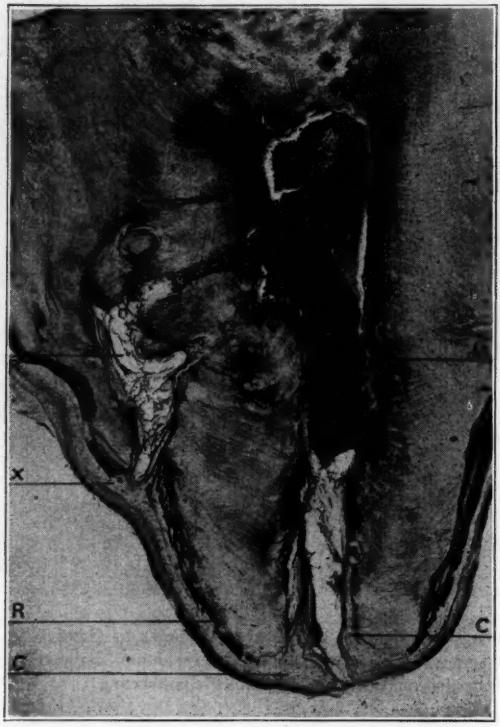

Fig. 7.—Cementum reaction six months after pulp removal; apex of buccal root of upper molar. *G*, guttapercha filling main canal nearly to apical foramen; *P*, collateral branches of root canal; *R*, resorption in cementum and dentin covered by new layers of cementum (*C*) creeping upward into canals.

If the force strikes the tooth with a sudden blow, the resulting injury may be more serious. A root may be split or broken into several pieces. A case of

membrane has been formed which also completely surrounds the fragment and extends to the alveolar bone. The space containing this new periodontal tissue is

very regular and closely resembles the normal periodontal space of the body of the root. The broken root end has also been repaired by layers of new cementum, to which periodontal membrane is attached.

Another root of a tooth from the same dog (Fig. 5) was evidently split, but separated only slightly, and connective tissue has grown up from the periodontal membrane into the crevice. Along the margins of the split dentin, a layer of new cementum is being deposited by cementoblasts, which have been produced by this ingrowing connective tissue. This deposit of cementum is the beginning of repair that would probably have entirely closed this crack in due time had the dog not been killed.

A case similar to that shown in Figure 5 was described by Gottlieb,[6] showing the root of an upper cuspid broken into many pieces by a heavy blow. Every fragment was covered over with cementum, and not only was the fractured end of

Fig. 8.—Another section of root in Figure 7, showing communication between the unfilled lateral branches *(P)* and guttapercha *(G)* in main canal.

6. Gottlieb, Bernhard: Histologische Untersuchung einer geheilten Zahnfraktur, Ztschr. f. Stomatol., 1922, Vol. 20, No. 5.

the root covered over, but also cementum extended well up into the root canal lining the walls with this hard substance. In another case of this type, described by Boulger,[7] two lower central incisors were broken. The fragments separated from the main root and were covered with cementum and surrounded by periodontal tissue. A beautiful example of repair is found on the main root surface, and the fiber bundles of the periodontal membrane are entirely restored.

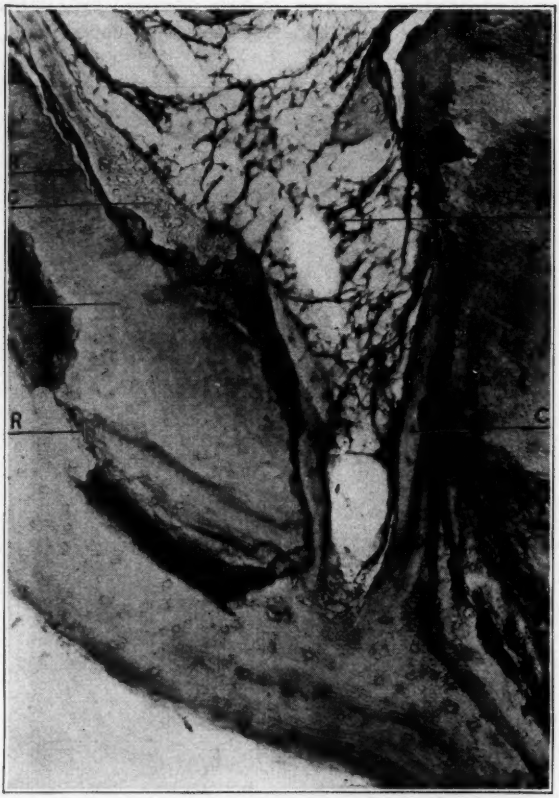

Fig. 9.—Higher magnification of area *(X)*, Figure 7. *D*, dentin; *C*, deposits of cementum replacing atrophic pulp tissue *(P)*. *R*, rough border of dentin where resorption preceded deposit of cementum.

Quite a number of references to fractured roots can be found in the literature, many showing repair by new deposits of cementum over the broken surfaces and a few showing repair of cracks in the

7. Boulger, E. P.: Histologic Studies of Specimen of Fractured Roots, J.A.D.A., 15: 1778 (Dec.) 1928.

dentin. Unusual cases of this character are reported by Euler and Meyer[8] and by Kronfeld.[9]

Experimental injuries of the roots of dog's teeth have been reported by Noyes,[10] Thomas[11] and Sippy,[12] showing repair of the injuries by new deposits of cementum. Thomas says that "recementation of artificially exposed dentin seems an easy possibility."

Another type of cementum resorption, independent of external causes, being due to systemic disturbances, is found in asso-

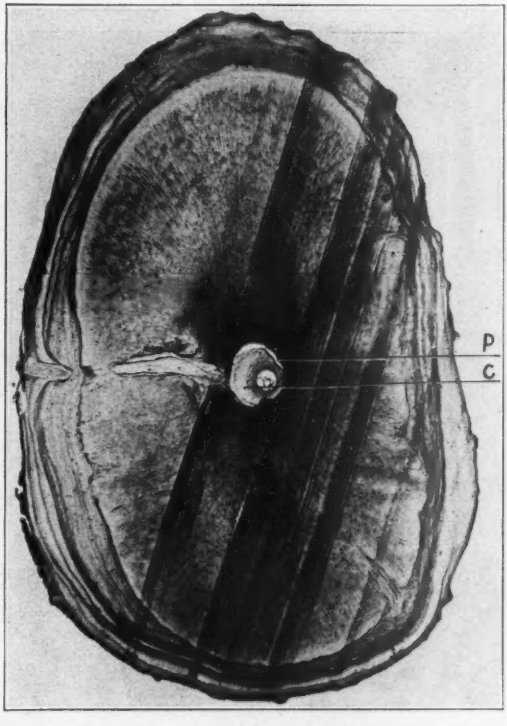

Fig. 10.—Cementum reaction in eight years following pulp removal; cross-section through root of a lower bicuspid. *P*, pulp canal and side branch extending to surface of root at right angles to main canal. *C*, cementum filling canal and side branch.

8. Euler and Meyer: Pathohistologie der Zähne, pp. 74,78.

9. Kronfeld, Rudolf: Ueber den Ausgang traumatischer Pulpenschädigung, Ztschr. f. Stomatol., 1929, Vol. 27, No. 9.

10. Noyes, F. B.: Report on Experiments on Artificial Injuries to the Peridental Membrane of Dogs, Dent. Rev., 28:883 (Sept.) 1914.

11. Thomas, N. G.: Studies in Protective Cementum Development, Dent. Cosmos, 64: 385 (April) 1922.

12. Sippy, B. O.: Regeneration of Tissues Following Experimental Injury of Tooth Roots, Dent. Cosmos, 69:771 (Aug.) 1927.

ciation with diffuse atrophy of the alveolar bone. In his original article on this subject, Gottlieb[1] has shown the illustration seen in Figure 6. This patient died from influenzal pneumonia. In all teeth, extensive shallow areas of resorption were found on the root surfaces. These areas represent a loss of support with a corresponding change of normal periodontal tissue to granulation tissue, which causes pressure on the root surfaces and results in pathologic wandering of the teeth. If such resorption should be repaired by new cementum, the teeth would again be able to withstand the normal functional stress and the tooth would be firm in its socket.

Another case of similar systemic origin has recently been reported by Mueller and Rony.[13]

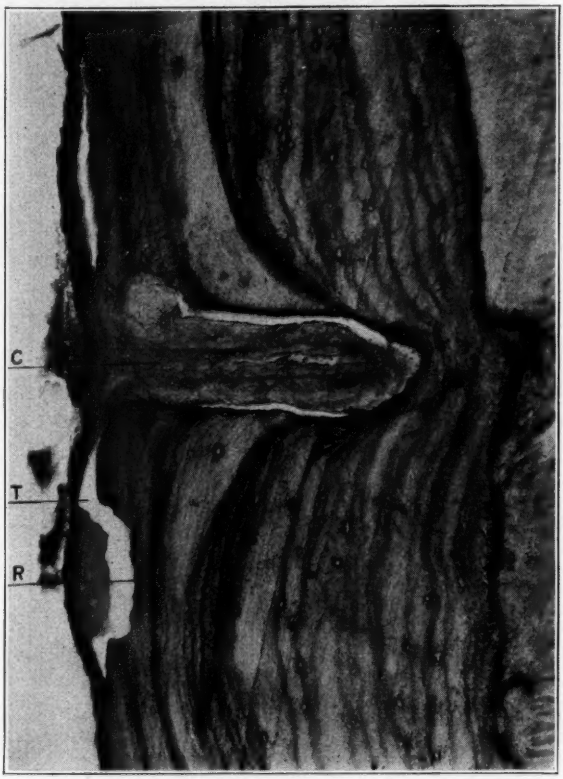

Fig. 11.—Higher magnification of foramen of side branch shown in Figure 10. *C*, cementum filling foramen; *T*, a tear in cementum during preparation; *R*, resorption in original cementum filled in by a new deposit at the same time that lateral branch of root canal was obliterated.

After pulp removal, another type of

13. Mueller, Emil, and Rony, H. R.: Laboratory Studies of an Unusual Case of Resorption, J. A. D. A., 17:326 (Feb.) 1930.

cementum change can be seen. Figure 7 shows the apex of the root of a tooth (from a man, aged 48) from which a vital pulp was removed under local anesthesia six months previous to extraction of the tooth. The guttapercha canal filling can be seen filling the canal quite well to a point very close to the apical foramen. The remaining pulp stump, as well as a collateral branch of the pulp, shows atrophic reticular degeneration, and cementum is being laid down along the walls of the canals, creeping upward from the apical foramen. It is very evi-

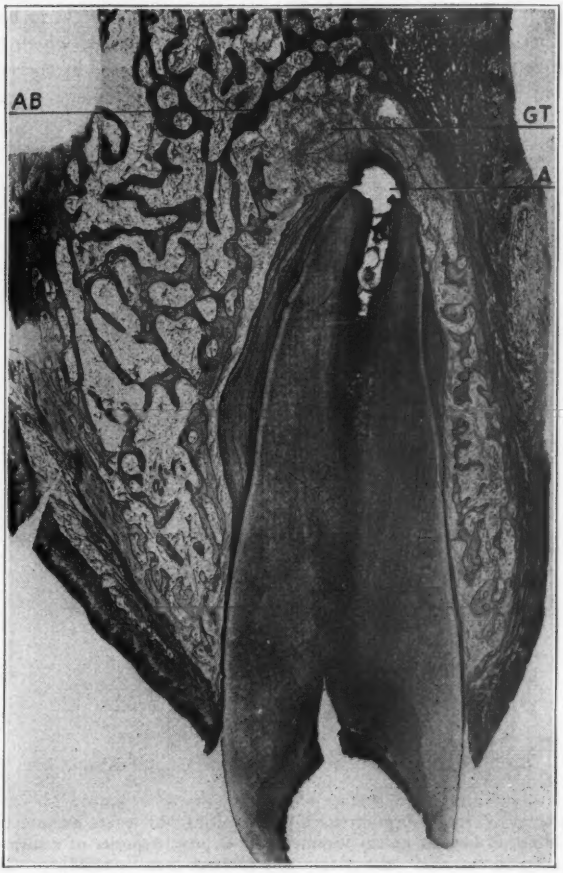

Fig. 12.—Labiolingual section of human upper central incisor. The crown was destroyed by caries and the pulp became gangrenous. Around the apex is a chronic inflammation of the periodontal tissue. *A*, abscess cavity; *GT*, granulation tissue (granuloma). *AB*, alveolar bone. Widening of the apical periodontal space is due to the replacement of bone by granulation tissue.

dent that resorption took place along the surface of the root canal walls after removal of the pulp, and that these areas have been repaired by the new deposit of cementum extending upward into the canals. This suggests the probability of a continuation of the filling-in process, with eventual obliteration of the remaining pulp stumps.

In Figure 8, the collateral branch of the same root is better shown, and the repaired areas of resorption are much more in evidence. A reactive inflammation following the shock of pulp removal probably produced the initial resorption, which later was checked, repair being well under way at the time of extraction. In a higher magnification of this area (Fig. 9), the atrophic character of the pulp stump is more clearly revealed. The illustration also shows the irregular edges of the resorption areas in both canal and surface of the root, which have been repaired and covered by successive layers of new cementum. The large cell bodies enclosed in this repair cementum show the high vitality of the new deposit.

Fig. 13.—Apical area of labial surface of the root shown in Figure 12. Irregular surface of dentin indicates where resorption took place during the acute inflammation following spreading of infection beyond apical foramen. At *C*, new deposits of cementum have filled some of the irregular area of resorption. *AB*, alveolar bone rebuilding. *GT*, granulation tissue indicating a chronic inflammation.

Another case of long standing (Fig. 10) shows the result of the continued progress of cementum repair. The ques-

tion as to the fate of pulp remnants and inaccessible ramifications of the pulp after its removal has been the source of much opposition to the retention of pulpless teeth. Because of this uncertainty, many operators refuse to undertake pulp removal even in the most favorable cases.

and the canal filled with guttapercha as far as was considered necessary but not quite to the apical foramen. The tooth remained in the mouth for eight years before extraction. In comparison with Figures 7 and 8, it is very noticeable that, in the longer time it remained in position, much more progress was made in

Fig. 14.—Higher magnification of area *X*, Figure 13; same root surface near foramen. *D*, dentin of root; *RL*, resorption lacunae; *O*, osteoclasts resorbing root surface; *I*, round-cell infiltration in periodontal tissue.

The illustration (Fig. 10) shows a cross-section of a bicuspid (from a woman, aged 35) from which the pulp was removed by local anesthesia in 1920,

the transformation of the pulp remnants into cementum. The main canal is well filled with this hard substance, only a very small central area remaining, which

shows an atrophic pulp remnant. The collateral branch is seen to be entirely filled with cementum.

In the higher magnification (Fig. 11), the new cementum laid down on the surface of the root near the foramen of the collateral branch is shown to be torn away slightly from the old cementum. An area of resorption is seen in which new cementum was laid down at the same time that the collateral branch was filled in. This repair cementum was torn away with the outer layer, which would indicate that the last deposit was more firmly attached to the reparative cementum than the latter was to the old cementum. Such areas of resorption are usually found on the surface of roots in the vicinity of the foramina after pulp removal. The possibility of repair, we be-

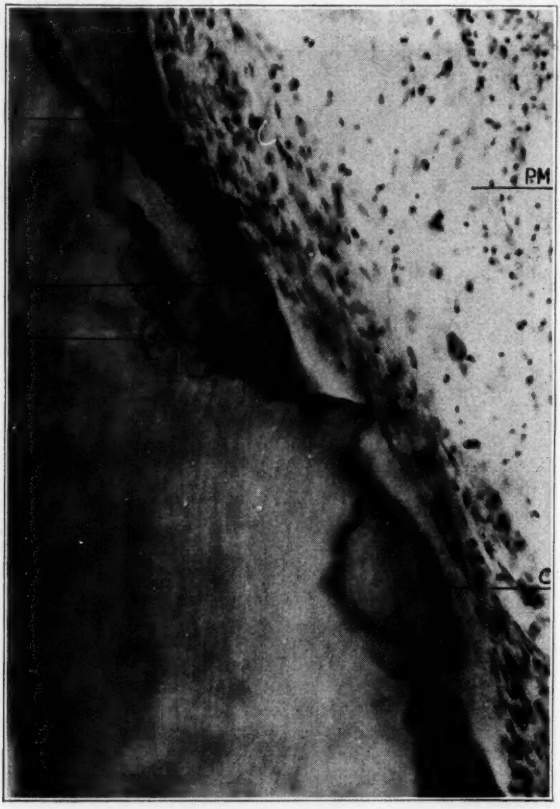

Fig. 15.—Higher magnification of root surface in Figure 13 *(C)*, where cementum repair was in progress. *R*, jagged surface of dentin; *C*, new cementum deposits; *PM*, periodontal membrane showing less infiltration and dense layer of fibroblasts *(F)* and cementoblasts along surface of root.

lieve, is dependent on the absence of infection. First, resorption is caused by a reactive hyperemia of the periodontal tissue following the pulp removal. It has no real significance as a pathologic process, but is merely a transitory condition, if no infection occurs. New cementum

eration of tissue after artificial injuries. He found repair by new cementum deposits to be the same on pulpless teeth as on those containing living pulps.

Cementum deposits following pulp removal without infection have been shown, and now let us compare with those some

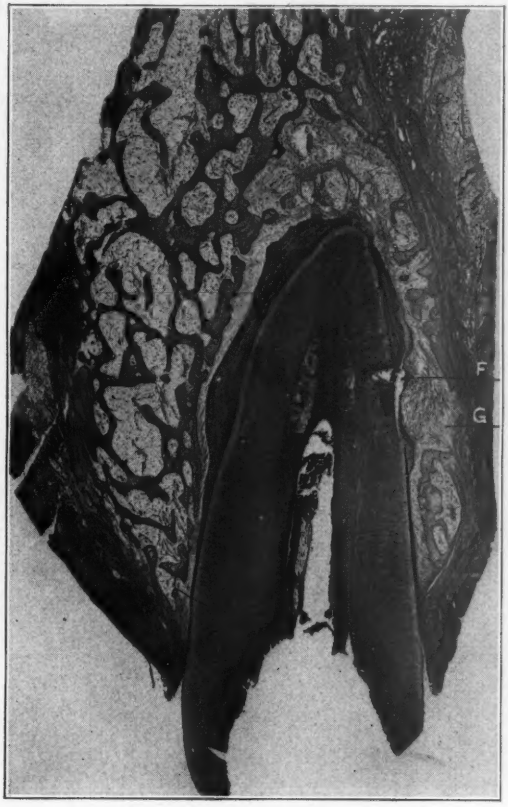

Fig. 16.—Another section of root in Figures 14-15, showing foramen *(F)* of collateral branch of canal. Chronic inflammation of periodontal membrane at lateral foramen. *G*, gap in labial plate of alveolus due to inflammation.

very soon repairs the area and restores the normal outline of the root surface.

In 1926, Sippy[12] carried on a series of experiments on dogs to study the regen-

cases in which the complication of pulp gangrene and infection are present in the canal. In Figure 12, a section of upper jaw (from a man, aged 42, who died of

tuberculosis) isshown, with a labiolingual section of a central incisor. The apical portion of a root canal is seen containing decomposed pulp tissue, pus cells and ly infiltrated with inflammatory round cells. On the lingual side of the root, extending from the foramen fully half way up on the root surface, is an exten-

Fig. 17.—Higher magnification of area *F*, Figure 16, showing cementum hyperplasia *(C)* on either side of foramen; *L*, leukocytes at foramen; *GT*, granulation tissue; *R*, resorption of cementum and dentin near lateral foramen due to former acute inflammation. As the inflammation subsides, new deposits of cementum appear in the periphery of the area and gradually extend toward the center of infection at the foramen filling in the resorbed area on the dentin. This is Nature's attempt at spontaneous healing of dentin adjacent to connective tissue.

other foreign substance. The periodontal tissue arouhd the apical foramen is dense- sive cement hyperplasia. This is undoubtedly due to functional stimulus at the time

the crown of the tooth was in occlusion, as could be seen by comparison with the next tooth, containing a living pulp which shows a corresponding cement hyperplasia. It is noticeable that the surface of this cementum shows no resorption, and numerous cell bodies lie embedded in its layers, indicating that it is a very vital young cementum. The opposite surface of the apex of the root shows deep resorption, leaving a jagged surface exposed to the connective tissue, above which another small cement hyperplasia appears. It is our belief that this indicates the former presence of a higher degree of inflammation, which, at the time the patient died, had become reduced in intensity. It is evident that the periodontal tissue was separated from the apex of the tooth and that all fiber bundles had disappeared. The alveolar plate (lamina dura) is broken and the periodontal space is greatly enlarged in the apical region.

Figure 13, the resorbed surface of the root apex, shows densely infiltrated tissue close to the apical foramen, with a gradual lessening of infiltration higher up. No fiber bundles are to be seen in this area, but loose connective tissue fills the space between the bone and the root. In the upper portion, some new cementum is seen on the jagged dentin surface. Opposite this repair, a spicule of alveolar bone is seen projecting, as if functional repair might be started.[8]

In Figure 14, active resorption is shown on the jagged root surface near the apex. Osteoclasts can be seen in the resorption lacunae, and there is no evidence of repair taking place. The connective tissue

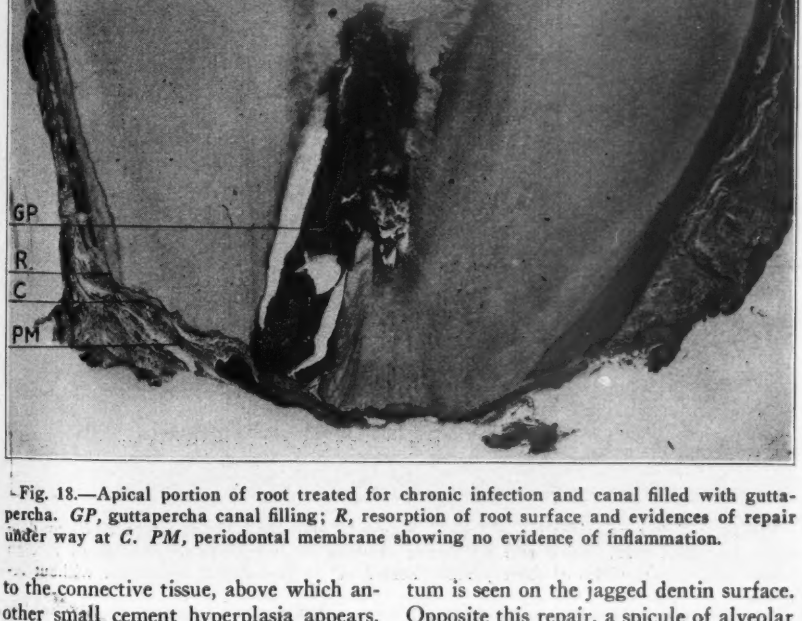

Fig. 18.—Apical portion of root treated for chronic infection and canal filled with guttapercha. *GP*, guttapercha canal filling; *R*, resorption of root surface and evidences of repair under way at *C*. *PM*, periodontal membrane showing no evidence of inflammation.

shows round-cell infiltration in which many polymorphonuclear leukocytes appear.

Figure 15 shows the area slightly higher up on the same surface, where repair is filling in the resorbed areas of the root surface. The presence of this newly deposited cementum and the character of the cells in the connective tissue give conclusive evidence for the opinion that the defensive mechanism has overcome the progress of the inflammation in this area and round cells have been replaced with fibroblasts and cementoblasts. There is little doubt that an acute inflammation had occurred, followed by a more chronic process at the time of death. At the time of the acute attack, the root surface was resorbed for a considerable distance from the apical foramen. As the acute inflammation subsided, the process became more localized about the apical foramen, and a reparatory deposit of new cementum occurred in the more remote part of the resorbed root surface.

This explanation of the occurrence of repair in these resorbed areas is supported by the condition found about an accessory foramen in another portion of the same root. In Figure 16, this foramen is shown, surrounded by an infiltrated tissue very similar to that seen about the apical foramen. The alveolar bone shows a large gap opposite this foramen due to the inflammatory process. On each side of the foramen, a cement hyperplasia can

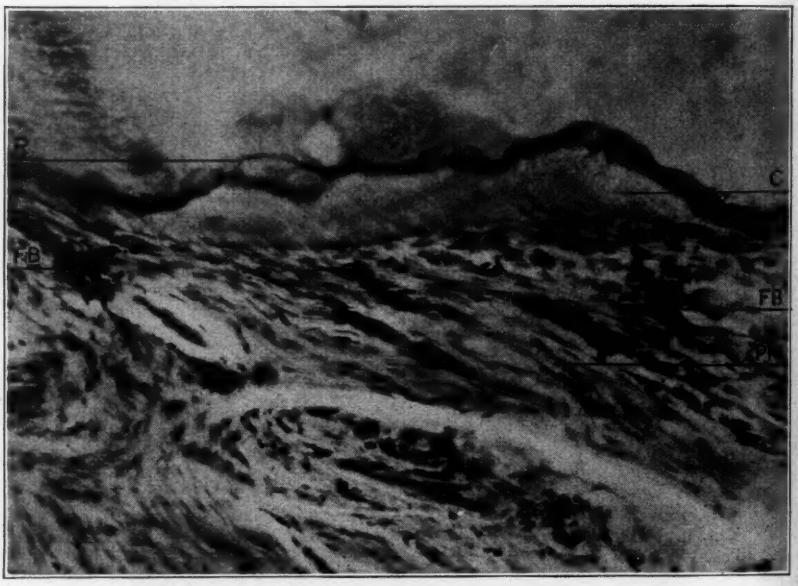

Fig. 19.—Higher magnification of area *C*, Figure 18, showing cementum repair *(C)* on dentin of root *(R)*. *PM*, periodontal membrane showing no inflammation; *FB*, small foreign bodies, probably particles of chloropercha "healed in" in periodontal membrane without reaction.

be seen, and the higher magnification of this area (Fig. 17) shows the significance of this newly deposited cementum. From the opening of this canal extending in each direction, resorption of the original root surface took place. After a time, the inflammatory process diminished and became more localized about the foramen. Repair cementum was deposited on the surface some distance away and gradually came closer and closer to the foramen, covering the exposed dentin as well as the roughened surface of the old cementum. The presence of this newly deposited cementum on each side of the area of inflammation is significant as evidence of subsiding inflammation. The presence of a vital cementum stimulates

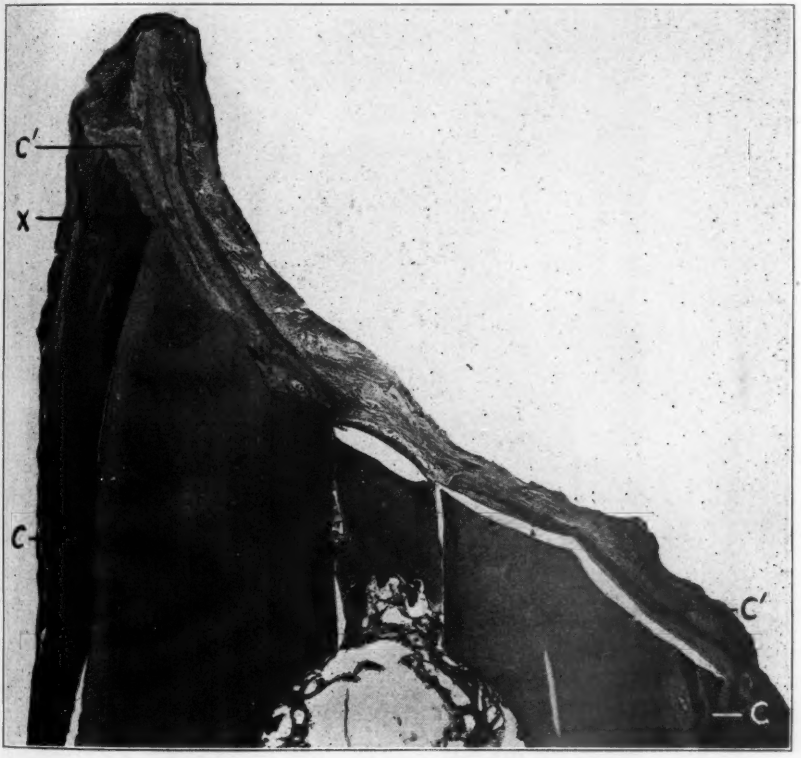

Fig. 20.—Repair following root resection where chronic infection had been present for many years. The root was treated with antiseptics, refilled with guttapercha and later resected. The central area shows the guttapercha canal filling. New cementum deposits at *C′* cover both old cementum *C* and exposed dentin. Connective tissue band covers the exposed guttapercha. Restored periodontal fiber bundles extend from new cementum to alveolar bone. (Coolidge: Root Resection as a Cure for Chronic Periapical Infection.)

functional repair of the lost alveolar bone and reestablishment of principal fibers to support the tooth against occlusal stress. If such a repair could take place with the biologic forces working alone, might we not expect as much or more had the source of the infective process been removed by treatment of the canal and the removal of the infection?

In Figure 18, a lower cuspid root (in a man, aged 60) is shown which gave roentgenographic evidence of a chronic inflammatory condition of long standing. The canal was cleaned, treated with antiseptics and refilled in 1920. After a few years, the roentgenogram revealed a very much better condition about the root apex. The bone in

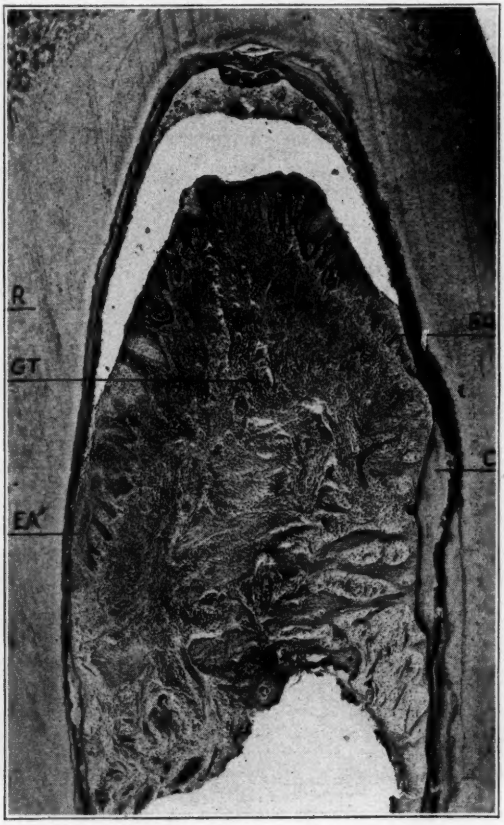

Fig. 21.—Bifurcation of roots of lower molar tooth. *R*, mesial and distal roots; *GT*, inflamed gum tissue between the roots covered with epithelium. *EA* and *EA'*, epithelial attachment to root surfaces. *C*, cementum hyperplasia at lower end of epithelial attachment. At *EA*, the attachment is higher than at *EA'* and no cementum hyperplasia can be seen here (*EA'*).

the apical region had been restored so that the case was considered healed. Seven years later, the tooth was extracted, and microscopic findings have confirmed the former evidence of a very satisfactory healing process. The connective tissue shows no inflammatory cells. The previously resorbed areas show new deposits of cementum, covering both the old cementum and the resorbed dentin.

The character of the tissues becomes more evident in the higher magnification in Figure 19. It has always been supposed that dentinal tubules once exposed to inflammatory exudates become so filled with these decomposing products that repair could not take place.

This finding is evidence against such a conception. It also shows a greatly improved condition over that shown in Figure 12, when no treatment or canal filling was instituted to remove the infection.

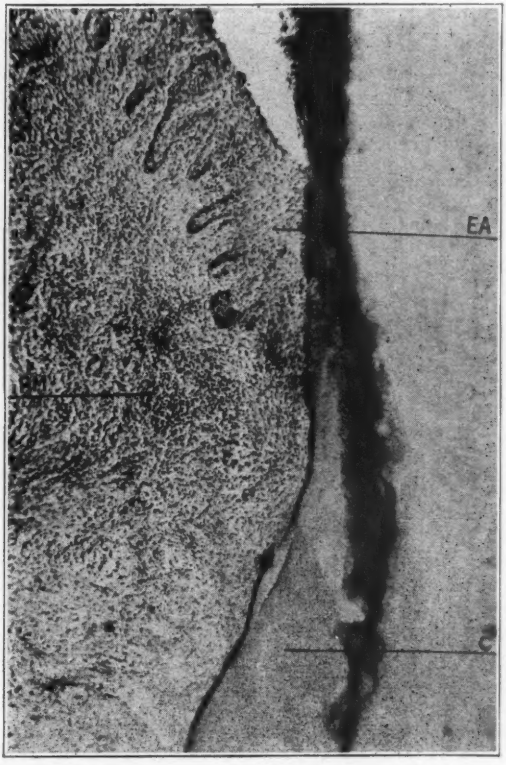

Fig. 22.—Higher magnification of area *EA*, Figure 21. *EA*, epithelial attachment; *C*, cementum hyperplasia; *PM*, infiltrated periodontal tissue.

In 1930, a case of very purulent chronic

inflammation surrounding a bicuspid root apex was reported,[14] in which both canal treatment and root resection were performed (Fig. 20). When the root was extracted, after fourteen years, it was found to be completely repaired by new deposits of cementum covering both old cementum and the resected surface of the dentin. Even though a persistent inflammation with pus had surrounded this root, there was complete repair by cementum newly deposited on the resected surface. No inflammatory cells were found in the connective tissue, and the principal fibers had been reattached to the new cementum surface and are plainly seen extending between the new cementum and alveolar bone in the usual orderly manner.

The significance of these illustrations of new cementum deposited on resorbed dentin where infection, pus and necrotic tissue had been present is great, indicating that new cementum will repair such pathologic injuries when the inflammatory process is controlled. It also sug-

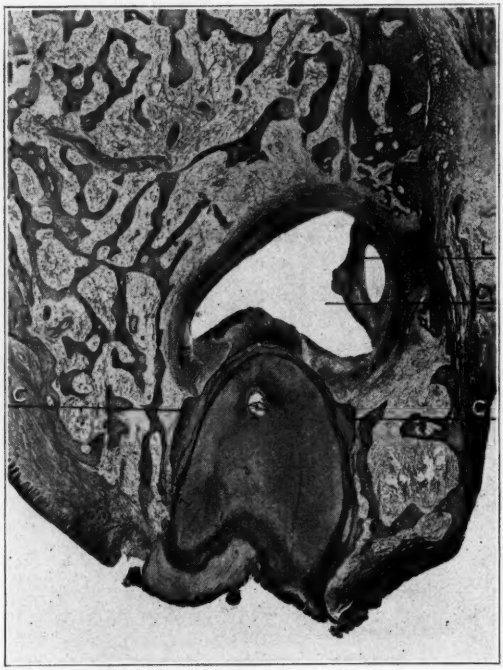

Fig. 23.—Labiolingual section of root of human molar tooth having gangrenous pulp. The apical foramen cannot be seen in this section. *CY*, large cyst cavity around apex of root; *L*, fluid and leukocytes. *C-C*, cementum hyperplasia at point where cyst wall approaches root surface.

14. Coolidge, E. D.: Root Resection as Cure for Chronic Periapical Infection: A Histologic Report of Case Showing Complete Repair, J.A.D.A., 17:239 (Feb.) 1930.

gests a possibility of repair along the side of the root under similar conditions, if such can be established. The gingival crevice is lined with epithelial tissue which is attached to the tooth at the bottom of the crevice. The bottom of the crevice does not remain in the same position on the surface of the tooth during the continued. Instead of a vital, healthy substance which might attach new Sharpey fibers to the root surface, an unresponsive surface is presented, and replacements by new tissue elements cannot be substituted for old ones which are wearing out. Hence, epithelium grows along the surface of the root, where con-

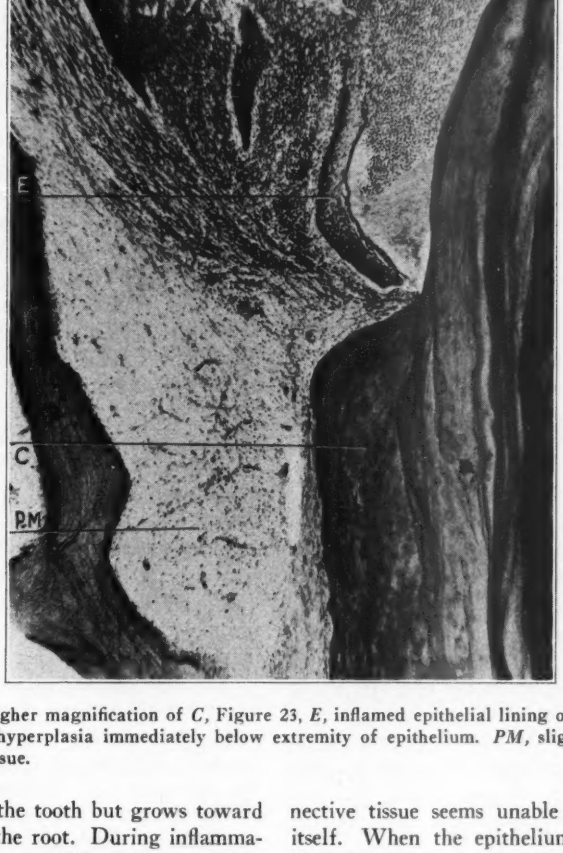

Fig. 24.—Higher magnification of *C*, Figure 23, *E*, inflamed epithelial lining of cyst cavity; *C*, cementum hyperplasia immediately below extremity of epithelium. *PM*, slightly inflamed periodontal tissue.

life cycle of the tooth but grows toward the apex of the root. During inflammatory reactions caused by injury or infection, the normal deposits of new cementum by the cementoblasts seem to be dis- nective tissue seems unable to reattach itself. When the epithelium grows in, and while it is present, there is no further opportunity for the connective tissue to return.

In Figure 21, the bifurcation of a molar root is shown where the tissue has separated from the cementum and established a gingival crevice on each root. The surface of the papilla is covered with mouth epithelium, which forms a crevice on each root at different levels. On the left, the attachment of the epithelium to the cementum can be seen extending much farther toward the apex than on the right. A very evident cement hyperplasia on the right side seems to have slowed the downward growth of the epithelium here, and the character of the tissue is much better than that along the left side. New deposition of cementum is an evidence of the presence of a highly active tissue, and we see fewer signs of inflammation in this region. Many bundles of the principal fibers are present on this side, while they are missing on the opposite root. This relationship between the downward growth of epithelium and cementum hyperplasia was first shown by Gottlieb.[15]

The presence of new vital cementum indicates resistance, function and health, while proliferation of epithelium indicates a loss of vitality in the cementum. The function of the epithelium is only to cover and it does not afford a mechanical support. This fact is as well known from clinical observation as it can be shown by microscopic illustration.

In a higher magnification, seen in Figure 22, the epithelium is plainly shown to end above the new cementum. A heavy band of the principal fibers is seen leaving the smooth surface of the cementum and extending upward into the body of the soft tissue. The soft tissue shows considerable round-cell infiltration, due to a lack of oral hygiene.

Another type of reaction of cementum to the advance of an inflammatory process is seen in Figure 23 in the apical region of a tooth. A large cyst cavity is seen surrounded by a thick layer of epithelium. All normal periodontal tissue is destroyed in the region of the cyst, and the periodontal space has been enlarged in the apical region to form a cavity almost as large as the root. There is a prominent cement hyperplasia on each side of the root at the border of the epithelium surrounding the cyst. This new cementum has undoubtedly prevented the epithelium from proliferating further downward along the surface of the root.

In the higher magnification in Figure 24, the edge of the cement hyperplasia on one surface of the root is shown. These layers of cementum are a later deposit than that higher up, where the epithelium is present. The cyst cavity within the epithelium is filled with pus cells. Below the epithelium, adjacent to the new cementum, the tissue shows only a very mild inflammation.

Gottlieb,[1] Stein[5] and Orban[2] have called attention to the limitation of epithelial proliferation along the surface of a root by cement hyperplasia. These outgrowths of cementum are not a pathologic process but a response to some irritation. They may be looked on as indicating a favorable reaction of the periodontal tissue. They supply additional surface for the attachment of principal fibers and strengthen the support of the tooth.

The downward growth of this epithelium (Fig. 24) was apparently limited by the new cementum deposits just as the downward growth shown in Figure 21 was limited by fresh deposits of cementum in that region. In Figures 12 and 13, new deposits of cementum were shown where resorption of the root surface had taken

15. Gottlieb, Bernhard: Schmutzpyorrhoe, Paradentalpyorrhoe und Alveolaratrophie (Fig. 24), Vienna: Urban & Schwartzenberg, 1925.

place following an acute inflammatory reaction. It seems that during an acute reaction, building cells are replaced by resorbing cells. As the inflammation subsides, another change takes place. If connective tissue cells become stimulated, cementum is newly deposited and fills up the resorbed areas; fibers become attached to the new cementum, and by functional stimulus, alveolar bone is built out to support these new fibers, reestablishing the normal periodontal space and the intervening tissues. If epithelial cells are stimulated, this tissue proliferates along the surface as the inflammatory reaction subsides, before resorption takes place, and no possibility of repair is left while the epithelium is present. In other words, proliferation of epithelium sometimes precedes resorption and prevents the connective tissue process of repair, which is the only perfect and permanent form of repair. Resorption of hard tissue can be checked by the connective tissue cells under certain conditions, which we believe to be the control of the infection and inflammation resulting from bacterial irritants, while a surface covered by epithelium is forever shut off from connective tissue repair.

SUMMARY

1. Cementum has been shown to repair areas of resorption caused by functional trauma and fractures. The fragments and the fractured surface may be covered with new layers of cementum, and new periodontal fibers develop, establishing a functional connection between the cementum and the alveolar bone. Cracks in the dentin of the root caused by trauma have been shown to fill in with connective tissue, which lays down new deposits of cementum and gradually repairs the crack.

2. Small areas of resorption on the surface of the roots involving both cementum and dentin have been shown to be repaired by new deposits of cementum. Unrepaired areas weaken the support of the teeth and may result in loosening, and sometimes in pathologic wandering, of the teeth.

3. After removal of live pulp, many small areas of resorption are observed on the surfaces of the roots and canal walls where there are remnants of live uninfected pulp tissue. These areas are repaired with new deposits of cementum, and the pulp remnants are generally replaced by cementum both in the main canal and in accessory canals where infection has been controlled.

4. Both injury and resorption which occur on pulpless teeth may be corrected by repair in the same manner, and apparently about as successfully as on teeth containing vital pulps.

5. During acute inflammatory reaction, the periodontal tissues suffer more or less destruction. As the inflammation subsides, the tissue on the outer border of the inflammatory area is stimulated to activity. If connective tissue cells receive the stimulus, new and rapidly forming layers of cementum are deposited on the surface of the old cementum, gradually extending along the surface of the exposed dentin to cover it. Proliferation of epithelium along the surface of the root prevents the new cementum deposits from being laid down. On the outer border of such areas, cementum hyperplasia is found, which seems to limit the progress of proliferation of the epithelium along the surface of the root.

DENTIFRICES*

By WALTER HYDE, D.D.S., Minneapolis, Minn.

A REVIEW of the literature on the subject of dentifrices shows an amazing difference of opinion. Some writers advocate a neutral mixture, solely as an aid in the mechanical cleansing of the teeth, some urge the use of an acid preparation for the solution of the mucin plaque and the stimulation of the flow of the saliva; others advocate soap for its alkalinity, and others include various digestive and bactericidal agents.

For many years, practically all preparations for the care of the teeth were alkaline. This was due to the very general acceptance of Miller's theory of decay. If the bacteria of the mouth caused decay by the production of lactic acid, the logical thing to do was to brush the teeth and wash the mouth with an alkaline mixture to neutralize the acid. Later experiments have proved that any possible effect is so transitory as to be of little value.[1]

About 1912, some time after the first suggestion of the use of "food acids" mediums by Gies,[2] Pickerell[3] brought out some new ideas. He said, "We are therefore driven to the inevitable conclusion that alkaline dentifrices and mouth washes for the prevention of dental caries must be abandoned and we further conclude that some substance which is a salivary stimulant should be used in order to stimulate and educate the activity of the salivary glands. Now, it has been conclusively proved that the best substances for this purpose are acids and there is not the slightest reason why the best should not be used in this case." These ideas had quite a following at the time and various new dentifrices appeared on the market and are still available, some so elaborately prepared and put up that their various ingredients are not allowed to come in contact with each other until they are squeezed out onto the toothbrush.

Pickerell's ideas were largely theoretical and were based upon observations of aboriginal and racial characteristics rather than upon experiments of the degree of exactness that characterized the work of later investigators. His methods of testing saliva and solutions for acidity were particularly inexact as compared with those of Bunzell,[4] Carlson and McKinstry[5] and others.[6] Consequently, we find

*Read before the Section on Mouth Hygiene at the Midwinter Clinic of the Chicago Dental Society, Feb. 4, 1931.

1. Feirer, W. A., and Leonard, Veeder: Antisepsis in Hygiene of Teeth and Gums, J.A.D.A., 14:1049 (June) 1927.

2. Gies, W. J.: The Dentifrice Problem, J.N.D.A., 8:851 (Oct.) 1921.

3. Pickerell, H. P.: Prevention of Dental Caries and Oral Sepsis, Ed. 3, New York: P. B. Hoeber Co., Inc., 1924.

4. Bunzell, H. H.: Comparison of Soap and Soapless Dentifrices, Bulletin, Colgate and Co.

5. Carlson, V. R., and McKinstry, M. L.: Dent. Cosmos, 66:840 (Aug.) 1924.

6. McGeehee, W. H. O.: Present Status of Dentifrice Problem, J.A.D.A., 13:1599 (Nov.) 1926.

ourselves in some sympathy with Kells,[7] a forceful and clear thinking practitioner of dentistry, of much clinical experience. What he thought of the matter is certainly interesting history regardless of what may have been its value. In 1921, he said:

> The mere fact that the normal condition of the mouth is either neutral or slightly alkaline and that the introduction of an acid into the mouth induces an increased flow of an alkaline saliva is proof positive that the acid is harmful. Nature, when normal, is continuously on guard, and whenever anything harmful gains an entrance into the body, she at once endeavors to fight it off.
>
> Pickerell advocates the idea that a dentifrice should be a salivary stimulant. With all due deference to him and to his following, I do not hesitate to affirm that a salivary stimulant is the very last ingredient a dentifrice should contain. Where is the dentist who cannot clean and polish the teeth in the upper arch of any patient when he can keep this operative field comparatively dry and free from saliva, better than he can the lower teeth, which in some patients are practically flooded with saliva all the time. The slimy nature of the saliva renders it most difficult, or even impossible, to polish the teeth. Such being the case when the dentist is trying to clean the teeth of a patient, why do not the same conditions obtain when the patient is trying to clean his teeth himself? They certainly do.
>
> Any experienced dentist will indeed insist that the less saliva there is in the mouth during the process of brushing the teeth, the better for the patient, and that instead of a dentifrice containing an acid fruit juice or any other stimulating substance in order to increase the flow of saliva, it should, if possible, contain some ingredient to produce just the reverse effect, to reduce the flow of saliva. It is no unusual occurrence for a patient to state that the teeth are all "on edge" and exceedingly sensitive.
>
> The first inquiry is as to diet, and we invariably find that acid fruits, oranges, grapefruit and lemons, have been recently used in unusually large quantities. A change of diet is recommended, and also alkaline mouth washes and in a week or two the mouth is again in normal condition.
>
> Let us view this, not from a theoretical standpoint, but from a common sense point of view, that is, from that of a practical and experienced dentist. We know that acid fruit juices will dissolve the enamel. We know, and no one will deny it, that every time an acid fruit juice is taken into the mouth it will attack the enamel, if in sufficient quantity and given sufficient time. Knowing these facts, we can readily see the danger of acid fruit juices used in a dentifrice two or three times a day, when the manufacturers themselves admit that they rely upon the alkaline saliva to come along at the right instant to neutralize them, and thus prevent them from doing harm. What if the neutralizing agent misses connections? This theory appears absolutely ridiculous because I believe it is reasonable to assume that many a time the acid will get a chance to attack the enamel before it becomes neutralized. Pickerell himself, however, never did make any such ridiculous claims, but believes the contrary, as the following quotation will prove. "Undoubtedly there is a short time during which the acid remains unneutralized, but is not sufficient to cause any effect except upon the occlusal surface." This is merely a statement of opinion, and the wonder is that the acid will affect the occlusal surfaces only and not the others. As a matter of fact, I see no reason to believe that it will not affect the others as well, and from clinical evidence I believe it does. We also find the following statement (p. 232). "There are, however, two dangers to guard against—those of using an acid either too weak or too strong. If an acid be used in too weak a solution it will do more harm than good. If an acid be used in too strong a solution it may have a precisely similar effect." These admissions from the father of the acid dentifrice theory would spoil the effect for me, even if I had been slightly inclined toward it.

The extensive experiments carried on by Bunzell indicate that the claims of the advocate of acid dentifrices as to the production of a prolonged alkalinity are not well founded. He found considerable individual variation—variation at different hours of the day and, in all cases, a

7. Kells, C. E.: Question of Dentifrices, J.N.D.A., 8:609 (Aug.) 1921.

prompt return to the usual condition, regardless of the character of the dentifrices. He found, in fact, that the chewing of paraffin was a greater stimulant to the flow of alkaline saliva than the use of any dentifrice, but no evidence has been presented to show that such a thing is beneficial to the teeth.

The studies of Michaels[8] show that there is a high acid reserve in the saliva in immunity and a high alkaline reserve in caries. His findings were corroborated by Marshall.[9]

The acid idea is probably the most revolutionary and novel one that ever came to the attention of the profession in regard to dentifrices. For a time, it attracted many followers and sold much tooth paste. Unfortunately, there seemed to be no lessening in the amount of caries. In fact, one of the claims made by Pickerell was that the use of an acid dentifrice increases the amount of ptyalin in the saliva, but since the action of ptyalin is to transform starches into dextrose and maltose, both of which are readily fermentable, through the action of bacteria, it may be that the use of acid defeated the very end that it was hoped to achieve.[6]

Another very hopeful claim made for acid was that the curdling effect on the mucin content of the saliva made it much easier to remove this plaque by means of the toothbrush. Investigators have found that mucin is deposited at p_H 4.58 and is redissolved at p_H 5.23, which suggests that such an effect is possible in such a narrow range of acidity as would certainly be difficult to achieve in the day to day use of a dentifrice.[6]

In connection with the subject of acids, there have been reports made by various agencies, notably the Research Council of the New York Academy of Dentistry and the Council of Dental Therapeutics of the A.D.A., on the so-called stain removers and tooth-cleaning preparations sold under various striking names to both the dental profession and the general public. These preparations are generally said to make the most stained teeth snowy white, and the labels carry the impression that the solution is harmless. Experiment has shown that exposure of the enamel to action of these stain removers for even brief periods of from one to five minutes produces a definitely etched area that is rough and much more readily penetrated by such stains as silver nitrate. Chemical analysis practically always shows the presence of a strong acid, usually hydrochloric or sulphuric. Such preparations are positively dangerous, and should, of course, never be used.

It is interesting to note that, in the same series of experiments,[10] it was found that a similar exposure (i. e. from one to five minutes) to lemon juice produces no effect, but a tooth left in lemon juice for twenty-four hours was definitely decalcified.

A fair conclusion from a consideration of all these facts is that "acid mouth" is not the cause of decay, but that "spot acid" in sheltered areas is probably a factor, and that attempts to change the amount or character of the saliva by means of dentifrices is a wrong approach to the problem.

Brody,[11] after considering the failure of alkaline or acid or antiseptic dentifrices to prevent dental decay, says:

8. Michaels, M.: Proc. Third Internat. Dent. Cong., Vol. 2, 1902.

9. Marshall, J. A.: Composition of Saliva in Relation to Incident of Dental Caries, J.N.D.A., 4:699 (July) 1917.

10. Bödecker, C. F.; Applebaum, Edmund, and Karshan, Maxwell: J. Dent. Res., 10:481 (Aug.) 1930.

11. Brody, Herman: Dent. Cosmos, 67:948 (Oct.) 1925.

The chief thing in its prevention simmers down to daily thorough and systematic cleansing of teeth by means of the tooth brush, dental floss, a mild pure neutral or alkaline dentifrice. All good dentifrices should contain soap. Soap, apart from its value as a cleansing agent, has antiseptic properties which should not be disregarded. It dissolves the fatty substance without attacking the teeth and it furthermore lubricates the bristles of the tooth brush, allowing them to penetrate into the interproximal spaces more easily.

What is soap? Soap embraces all those compounds which result from the reaction of salifiable bases with fats and oils. There are two official soaps—one, a soda soap, made with olive oil (castile soap); the other, a potassium soap (soft soap). The odor of soap is peculiar; its taste, slightly alkaline. It is soluble in water, more readily in hot water than in cold water. Its aqueous solution is alkaline to litmus. It is an antacid, an antiseptic and a detergent. The efficiency of a soap as a detergent depends on its hydrolytic decomposition when in solution, whereby alkali is liberated which saponifies and emulsifies grease and fatty substances, rendering them readily removable in the cleansing process. It also has the power of altering the surface tension of solutions and thereby profoundly affects the micro-organisms in the solution. In the entire realm of materia medica, there is not a single agent which is so useful as an ingredient of a dentifrice as a pure, mild and neutral soap.

Fones[12] says, "The most important ingredient in a dentifrice is soap."

A great many writers have advocated the use of soap in dentifrices. Among these men, there is some difference of opinion as to just what percentage of soap should be used for the best results. Probably about 5 per cent will give all the benefits without any danger of harmful effects. All agree on the value of soap as a cleansing agent and detergent. Alkaline soaps are germicidal because the alkali dissolves the bacteria, but there is always the danger that the gums will also be affected by this power to dissolve, and once the tissue is dissolved, in whatever degree, it does not grow back again.

The number of micro-organisms in the human mouth is startling. Feirer and Leonard[1] make the statement that scrapings from the gum margins contain a greater number of bacteria than many times the same bulk from fresh human stools. This suggests the use of active germicides, for if micro-organic life is associated with caries and the micro-organisms are so very abundant in the mouth, why not lessen their number and activity by using a good germicide? Here, we encounter several difficulties. A germicide to be incorporated into a dentifrice and be adaptable to use in the mouth would have to be (1) nontoxic, (2) nonirritant, (3) nonstaining, (4) stable and (5) rapid in action though diluted.

All sorts of agents have been used in attempts to meet these conditions, but by the time they are diluted to avoid harmful or unpleasant effects, they are not very effective as to reduction of bacteria in the mouth. The alkyl resorcinols, especially hexyl-resorcinol, come nearest to meeting these requirements, but it would seem that such bactericidal action should be resorted to only in special conditions of sepsis, and not employed by the ordinary individual presenting the usual mouth conditions, and, at best, the effect is but for a brief period of time.

All tooth powders and pastes contain some polishing agent. Those most commonly used in alkaline preparations are: talc with a comparative hardness of 1;

12. Fones, A. C.: Mouth Hygiene, Ed. 3, Philadelphia: Lea & Febiger, 1927, p. 287.

magnesium carbonate, 2.5; calcium carbonate (most frequently used), from 3 to 3.5; pumice, from 6 to 7. The acid pastes commonly contain tricalcium phosphate, hardness from 4 to 5. Enamel ranges in hardness from 5.5 to 7 and cementum and dentin from 3.5 to 5. Any ingredient with a greater degree of hardness would be too harsh for daily use and would be contraindicated.

If it is possible to dull the surface of a clean coverglass or watch crystal with a dentifrice, it is not safe for daily use, no matter how "bright" it keeps the patient's bridgework or how alluring the "practice building" sales talk that goes with the sample, with which the dental profession is so liberally supplied.

Many dentifrices are so built up with various coloring and flavoring matters, principally the essential oils, that they cannot be wisely used in the daily care of the mouth. Their use by children is especially contraindicated. The manufacturers purposely make these dentifrices strong because a great many people think a preparation of this sort is beneficial in proportion to its strength.

Although the enamel on a human tooth is the hardest and least permeable structure in the human body, it is quite possible to stain it by various agents. In days gone by, dentifrices were often colored to a marked degree, often to the point where they were quite unfit for daily use. Fortunately, the more modern preparations are not often objectionable on this score.

With some mouth washes, a great point is made of astringent qualities. But if some of the tissues in the mouth would be benefited by the application of an astringent, how is such a preparation to single out just the area where its service is required? No one ever saw a mouth where all the tissues needed an astringent.

It is certainly the duty of the dentist to warn his patients as to possible dangers from dentifrices and to advise them against extravagant claims on the part of the manufacturers. When an individual has a pathologic problem in connection with the care of the mouth, the matter should be approached from the point of view of the general physical condition and the diet rather than from that of the dentifrice. The dentist should satisfy himself as to the true nature and effect of any preparation that he does recommend or give to his patients.

There is a definite need for an authoritative body to whom the dentist can appeal for advice in problems of this kind. This need is being met by the Council on Dental Therapeutics of the American Dental Association. The reports of their findings are published from time to time in THE JOURNAL. These should all be read and filed for reference, and if the answer to your particular problem is not found, a direct appeal to the Council will always receive a reply. The Council on Dental Therapeutics will accept dentifrices for inclusion in the list of "Accepted Nonofficial Dental Remedies" provided:

1. Claims are strictly limited as to their efficacy as an aid in hygiene of the oral cavity and particularly to their mechanical cleansing properties.

2. No unwarranted therapeutic, chemical or bacteriologic claims are made or inferred in their presentation.

3. Therapeutically suggestive names are not used as a brand name.

4. The brand name is not indicative of a component which does not possess proven therapeutic properties.[13]

Finally, in a consideration of dentifrices, all that is needed for most people

13. Dentifrices, Council on Dental Therapeutics, J.A.D.A., 17:1943 (Oct.) 1930.

is a simple bland substance to aid in making the actual brushing more effective. The matter of odor and flavor is optional and, within reasonable limits, if the patient will do a better piece of work because it is pleasant, no one should object to the agreeable odor or flavor of a product.

It seems a reasonable conclusion that the sole purpose of a dentifrice is to aid pleasantly and harmlessly in the daily cleansing of the teeth.

CANCER OF THE TONGUE AND ITS PRECURSORS: A CLINICAL CONSIDERATION

By ARTHUR JOSEPH BARSKY, M.D., D.D.S., New York City

CANCER of the tongue is a condition which is more prevalent than is commonly supposed. In frequency, it is given second place to uterine cancer by Jesset,[1] third place by Jacobson[2] and fourth by Winniwater. In the age and sex distribution statistics of the Memorial Hospital of New York City, it is placed as the second most frequent carcinoma of men.

Despite the fact that the neoplasm is located on so accessible a structure, its mortality rate is astonishingly high, the percentage of fatalities being given as from 75 to 90 per cent by Warren,[3] Meller[4] and Butlin.[5] The high mortality rate may be attributed not only to the marked malignant character of the growth, but also to failure of early recognition of the cancer or of any of the precancerous states. The tongue is a muscular organ, rich in lympathics and so mobile that the movements squeeze the cells into the lympathics, and metastasis to the glands of the neck is frequent and early. Another factor in this high mortality is the common practice of applying silver nitrate or other caustics to ulcers of the tongue and the consequent reassuring dismissal of the patient.

It is indeed tragic that a malignant condition in so accessible a structure and arising almost invariably on a preexisting lesion of long standing should attain such a high fatality. It is even more deplorable that tardy recognition dooms so many to the list of the inoperable. The most encouraging statistics show 25 per cent cures. The elimination of this dreaded disease depends on careful examination and proper treatment of its precancerous manifestations.

The dentist's work is in the mouth. He should therefore examine the tongue in every case, particularly in persons over the age of 40. The examination should be careful and thorough. The tongue and floor of the mouth should be palpated bimanually. When the patient returns after a six months' interval, the organ should be reinspected. Prompt and energetic measures should be instituted to treat any of the precursors of epithelioma. Bloodgood[6] quotes thirty-three cases of

1. Jesset: Cancer of the Mouth, 1886.
2. Jacobson: Guy's Hospital Report, 1889.
3. Warren: Ann. Surg., Vol. 48, 1908.
4. Meller: Zentralbl. f. Chir., Vol. 84.
5. Butlin, H.: Diseases of Tongue, 1900.
6. Bloodgood, J. C.: Cancer of the Tongue, J. A. M. A., 77:1381 (Oct. 29) 1921.

malignancy in which a dentist did work in the mouth yet failed to note the condition. The elimination of many causes of lingual carcinoma lies in the hands of the dental profession. The appalling mortality rate is a challenge.

Before entering into a discussion of cancer of the tongue, a number of conditions will be considered which may be termed precancerous states. Of 160 cases of carcinoma of the tongue, Bloodgood obtained a history of precancerous lesions in 154. It must be borne in mind that these conditions are not in themselves always necessary to the development of cancer. Nevertheless, clinical experience has shown that they predispose to the development of cancer. Most of the forerunners are forms of chronic inflammation.

SYPHILIS

Syphilis of the tongue is secondary to carcinoma in frequency. It is a disease which simulates many other conditions, and the diagnosis is often very difficult. The various forms of syphilis, such as syphilitic warts, fissures, gumma, atrophic glossitis and leukoplakia, are often followed by cancer. Leukoplakia is the most frequent form of syphilis which develops into carcinoma.

The relationship of leukoplakia to syphilis is by no means definitely settled, for leukoplakia is not always due to syphilis; yet statistics clearly show that both of these conditions are related to cancer of the tongue. Von Bergman[7] shows 34 per cent of leukoplakia in 159 cases of cancer. Fournier[8] estimates the percentage at 30. The frequency with which syphilis is found in cancer of the tongue varies considerably. Of 112 cases, Dorrance and McShane[9] found the Wassermann reaction positive in twenty-eight. They state that, in those cases in which the Wassermann reaction was positive, the malignant character of the growth was more marked. The course was shorter and more virulent. Ryall[10] states that the cases of cancer of the tongue under his care showed a history of syphilis in over 80 per cent. This, to him, demonstrates conclusively the intimate relation of the two diseases. Of 184 cases of cancer of the mouth, Fournier found syphilis in 155. Meller, found syphilis in seven only of 207 cases of cancer. Suffice it to say, in this relation, that the presence of syphilis itself is not sufficient to cause cancer, but a longstanding syphilitic lesion undoubtedly acts as a predisposing factor.

It is believed that the complication of an ulcer or fissure is usually necessary before leukoplakia becomes cancerous. The development of the leukoplakia into malignancy is manifested by epithelial hypertrophy and hyperplasia followed by hyperkeratosis, lymphocytic infiltration of the submucosa, papillomatous overgrowth and destructive invasion of the deeper tissues.

The neoplasm may also be preceded by syphilitic warts, fissures and gumma. Butlin (p. 316) cites a case of lingual cancer following gumma.

A man, aged 47, contracted syphilis about twenty years before the appearance of the cancer, and about two years later began to suffer from ulceration of the tongue. He frequently attended Baker at St. Bartholomew's Hospital, thirteen years before, for gumma of the tongue, and about ten years before a watercolor drawing was made of his tongue

7. Von Bergman: Quoted by Ewing (Footnote 14), p. 841.

8. Fournier: Wien. Klein. Rund., 1900.

9. Dorrance, G. M., and McShane, J. K.: Cancer of Tongue and Floor of Mouth, Ann. Surg., 88:1007 (Dec.) 1928.

10. Ryall, C.: Cancer of Tongue, Brit. M. J., April 5, 1913, p. 697.

as a typical case of ulcerating and sloughing gumma. Until a few months before, the disease had always yielded to the administration of iodide of potassium; but it then ceased to take effect. At the date of the record the epithelioma, which had commenced in the scar, had spread beyond the tongue to the adjacent structures and lymphatic glands.

Syphilis of the tongue should be treated by the syphilologist, the dentist assisting by maintaining mouth hygiene.

ULCERS

The very nature of the tongue and its surroundings makes it prone to ulcerations. Traumatic ulcerations of the tongue resulting from sharp edges of teeth, fillings or dentures are quite common. These ulcerations undoubtedly predispose toward cancer especially in syphilitics who use tobacco in excess. The elimination of this cause of cancer rests in the hands of the dentist.

The continual irritation to the tongue results in the production of an erosion, superficial at first, followed by a thickening of the regenerative epithelium, lymphocytic infiltration about the area and finally downgrowth of atypical cells.

I recently saw a case which is illustrative of this point. A man, aged 62, was edentulous except for a sharp tooth stump remaining in the upper jaw. When the mouth was closed this sharp tooth stump pressed on the left border of the tongue. It had produced an ulceration which was painful. The ulcer was covered with a slough, and its edges were sharp, irregular and eroded. Induration was present. The submaxillary lymph nodes were palpable. Biopsy confirmed the diagnosis of carcinoma.

In the simple traumatic ulcers of the tongue which have not persisted for too long a period, the elimination of the cause is sufficient treatment for the cure. The use of tobacco, alcohol, spicy foods and condiments should be immediately discontinued. A mild alkaline mouthwash should be used and the mouth and teeth kept clean. The Wassermann test should be taken, and if positive, the patient referred for antisyphilitic treatment. In general, it is our practice that all ulcers not definitely diagnosed as benign and not responding to treatment within a period of three weeks are regarded as malignant. They should then be subjected to the proper treatment, either by surgery, radium or a combination of both these measures.

Tuberculous ulcers of the tongue are infrequent. They practically never occur as primary conditions, but are secondary to pulmonary tuberculosis. They rarely attain large size, for the patient usually dies early. The differential diagnosis is often most difficult, but the negative Wassermann reaction, the absence of induration, the presence of pulmonary tuberculosis and the possibility of demonstrating the tubercle bacillus microscopically are aids to be borne in mind.

PAPILLOMA

Papillomas, or warty proliferations, are the most common benign tumors of the tongue. They occur at any age (many are congenital) and are found most frequently on the dorsum. Papillomas arise on the dorsum from leukoplakia, syphilis, the irritation of bad teeth or fillings and glossitis due to tobacco. It is evident that the etiology corresponds to that of epithelioma of the tongue.

Although papillomas are benign, they often tend toward malignancy. Ulceration, increase in size and induration indicate the transformation of the innocent into the malignant tumor. This is of particular emphasis since many lingual cancers show a papillomatous stage. The point of prime importance is the differ-

ential diagnosis from carcinoma. The history and nature of the growth, its ready response to radium and the failure of reoccurrence are aids here. Involvement of the glands of the neck would suggest malignancy. Biopsy should never be neglected.

The treatment is by surgery or radium.

TOBACCO

Tobacco appears to be an offender not only in the production of cancer itself, but also in the causation of leukoplakia, which has been shown to be a definite precancerous lesion. Tobacco probably acts as an irritant and produces a chronic oral hyperemia with lymphocytic infiltration of the submucosa, erosion and ulceration followed by downgrowth of the epithelium. At the first sign of soreness of the tongue, the use of tobacco should be immediately discontinued.

Since statistics show that the incidence of cancer of the tongue is greater among men, it is interesting to note that, according to Waring,[11] in the Orient where women use tobacco as much as men, cancer of the tongue does not appear to be more prevalent than in western countries.

CANCER

There is no room in a brief clinical discussion of this nature for a theoretical survey of the etiology of cancer; hence, this part of the subject will not be touched.

Incidence.—In a comprehensive article, Pack and LeFevre[12] discuss this phase of the subject in great detail. They report a series of 788 cases of epidermoid carcinoma of the tongue, and give from 50 to 60 years as the period of greatest age distribution, but from 60 to 70 as the period of maximal incidence. It is infrequent in early life; but they refer to authentic cases reported by Variot, in an 11-year-old boy, and by Liston, in a 12-year-old girl. The reasons given for the rarity of this condition in youth are: 1. The responsible irritants may not yet be present. 2. Irritants when present have not had time to act. 3. Syphilis is not so common in the young.

The ocurrence in early life appears to be equal in male and female. In the Memorial Hospital series, 13.1 per cent occurred in females. This is compared with other statistics as follows: Whitehead 15 per cent in females; Kocher 5 per cent; Dorrance and McShane 4.2 per cent, and Wolfer 3 per cent. The reasons given for the low percentage among females are: 1. Women observe better oral hygiene than men. 2. Women have less leukoplakia, pyorrhea and syphilis. 3. The majority of women still have less irritation from tobacco. These points are open to argument and the third does not coincide with Waring's statement.

The racial incidence has been discussed by Sourasky.[13] He believes that there is a low incidence of cancer of the tongue among Jews.

The well known association of lingual cancer with chronic superficial glossitis, which is so often of syphilitic origin, explains the low incidence of cancer of the tongue among Jews, as syphilis is decidedly less common among Jews than among non-Jews—and was still less common in the past. Into the cause of the low incidence of syphilis among Jews, there is no need to enter here; it is sufficient to note that the low incidence of syphilis

11. Waring, H. J.: Surgical Treatment of Malignant Disease, New York: Oxford University Press, 1928.

12. LeFevre, G. T., and Pack, R. G.: Age and Sex Distribution and Incidence of Neoplastic Diseases at Memorial Hospital, N. Y. C., J. Cancer Res., June, 1930.

13. Sourasky, M.: Low Incidence of Cancer Among Jews and Problem of Specific Racial Factor, Cancer Conference, London, 1928.

among Jews explains the low incidence of cancer of the tongue.

Location of the Lesion on the Tongue.—Butlin gives a table of 80 cases showing locations of the lesions: root, one; anterior half and tip, three; right border, twelve; left border, seventeen; right side, eleven; left side, sixteen; border, one; dorsum, fifteen; right underside, two; left underside, one; whole tongue, one; total, eighty.

If one totals the lesions found on the right border, side and underside, one finds twenty-five cases on the right side in comparison to thirty-four cases on the left side. I believe that this is accounted for by the fact that the majority of people are right handed and hold their cigars or cigarets in the left side of the mouth.

The anterior part of the tongue is much more exposed to tobacco and to injury from bad teeth, etc., than the posterior part of the tongue, and this readily explains the relative infrequence of cancer behind the V of the circumvallate papillae.

Clinical Types.—There are three clinical varieties, ulcerative, infiltrating and hypertrophic.

Ulcerative type: A superficial ulceration arises from a previous lesion, as an erosion, abrasion, or fissure. The ulceration, with base and edges indurated, grows rapidly, extending over considerable area and is accompanied by much pain and discharge. The tumor may begin as a nodule beneath the mucosa, increasing in size, and finally breaking down and leaving a deep irregular ulceration.

Infiltrating type: Following leukoplakia, the neoplasm appears as a white or light grayish broad induration. After a variable length of time, this infiltrates widely into surrounding tissue, and finally may ulcerate.

Hypertrophic type: This takes the form of a raised papillomatous lesion, appearing as a hypertrophic, exuberant, cauliflower-like neoplasm. The surface may be ulcerated.

Course.—Extension to the lymphatics and adjacent structures is rapid and wide. Early in the course of the disease, the floor of the mouth, the base of the tongue, and pillars of the fauces and the tonsils may be affected, and the tumor may even extend to the base of the skull.

Lymph gland metastasis occurs early, involving, as a rule, the glands which directly drain the affected area, but often there is bilateral metastasis even though the tumor is on one side of the tongue. In certain cases, nodes close to the growth may escape involvement, while others further on are affected. Ewing[14] believes that the extension to lymphatics is by embolism of the tumor cells. The submaxillary nodes are first affected, then the superficial, and later the deep, cervical glands. The submaxillary salivary gland is rarely involved by metastasis. The palpable nodes have a hard, fixed feeling. About 80 per cent of the glands removed show malignancy under the microscope.

Metastasis to the organs, although rare, may occur, the liver, lungs, pleura, suprarenals and heart being the usual sites.

Prognosis and Operative Mortality.—Sir John Bland-Sutton[15] says, "Lingual cancer often destroys life very quickly.... The average duration of life varies from six to twenty-four months from the time

14. Ewing, James: Neoplastic Diseases, Philadelphia: W. B. Saunders and Co., Ed. 2, 1922.

15. Bland-Sutton, J.: Tumors, Innocent and Malignant, New York: Paul C. Hoeber, 1917, pp. 322, 323.

the cancer is recognized. The mortality of operation for the removal of cancerous tongues is not less than 10 per cent."

Judd and New[16] of the Mayo Clinic report 61 per cent of their cases as inoperable. Bloodgood reports 18 per cent of inoperable cases in a period of thirty-two years. In Quick's[17] series of 450 cases, he reports 35 per cent operable on admission; 50 per cent advanced, inoperable, and 15 per cent just past the operable stage. Bastionelli[18] believes that lesions at the tip of the tongue are more favorable for operation. He advised against operation in cancers at the base of the tongue, maintaining that in these he has not seen a single cure.

Treatment.—It is not intended that the scope of this article should include extensive data on the treatment of cancers of the tongue, for this is primarily a consideration of the precancerous conditions. Before discussing the actual treatment, I wish to refer to the subject of associated treatment, for a portion of this phase of the treatment must necessarily be undertaken by the dentist. G. E. Pfahler[19] of Philadelphia sums this up as follows:

> All patients with cancer of the mouth should have the following associated treatment:
>
> 1. An x-ray examination should be made of all of the teeth and of the alveolar process.
> 2. All diseased teeth should be removed, either at the beginning or as soon as sufficient radiation has been given to devitalize the cancer cells so that they will not be extended by the traumatism.
> 3. The mouth should be cleansed and kept clean. This will require much care and gentleness.
> 4. There should be a complete blood count made at the beginning and repeated from time to time during the treatment. If the patient is anaemic, appropriate treatment must be instituted.
> 5. A Wassermann test should be made in most cases, for a large percentage of mouth cancers develop upon old syphilitic lesions. Therefore, the presence of a positive Wassermann test does not eliminate the diagnosis of cancer and should not delay the treatment. Likewise, a microscopical diagnosis of cancer does not eliminate the possibility of associated syphilis. Both a microscopical diagnosis and a Wassermann test are usually advisable in each case.
> 6. When a section is taken for a microscopical examination, radiation treatment should be used either before or immediately afterward and should be continued until the lesion is proved not to be cancer, or until sufficient radiation has been used to cure the cancer. The fact that one considers a section necessary shows that cancer is a possibility. Under such management, with immediate associated radiation, I have never seen any bad effects from taking a section.
> 7. The nourishment of the patients must be carefully provided for otherwise they are likely to avoid food and lower their vitality.

Treatment of cancer of the tongue involves not only the primary growth but also the nodes of the neck. We have at our disposal surgery (including diathermy and cautery as surgical procedures) and the physical agents, radium and the roentgen rays.

Treatment of the Primary Growth.—It has been said (Cade)[20] that the surgical treatment of lingual cancer remains where Butlin left it thirty years ago. Butlin collected 333 cases, reported by various surgeons, with a primary opera-

16. Judd, E. S., and New, G. B.: Carcinoma of the Tongue, Surg. Gynec. Obst., 36:163 (Feb.) 1923.

17. Quick, Douglas: Treatment of Cancer of the Lip and Mouth, Am. J. Roentgenol., 21:322 (April) 1929.

18. Bastionelli, M. R.: Quoted in the Radium Report of the Memorial Hospital, 1923, p. 41.

19. Pfahler, G. E.: Pure Gamma Radiation in Treatment of Carcinoma of Buccal Cavity, Cancer Conference, London, 1928.

20. Cade, S.: Radium Treatment of Cancer of Buccal Cavity, Cancer Conference, London, 1928.

tive mortality of 12.5 per cent and 20 per cent cures for a three-year period. The results of surgery are uninspiring and the trend of the times as indicated by the practice of such institutions as the Memorial Hospital,[21] New York City, and the Curie Foundation in Paris (Roux-Berger and O. Monod)[22] seems to turn toward the use of radium on the tongue and surgery for the glands.

Small ulcerations of doubtful malignancy are often excised and radium emanation needles later inserted if biopsy discloses malignancy.

Quick[23] uses surgery in tongue cases of bulky, fungating character with infection, to remove the bulk of the growth after the effects of irradiation are noted. He states that cancer on an area of a syphilitic leukoplakia or syphilitic glossitis does not respond well to the use of radium, owing to the very poor capillary blood supply and an increase in connective tissue throughout the growth. In connection with the use of radium, it is interesting to note that the more embryonal the type of cancer cell, the more sensitive it is to irradiation. On the other hand, the more adult the cell, the more resistant it is to radium. Quick feels that since this is the direct reverse of the prognosis of operative surgery, it explains the encouraging results produced by irradiation in cases operatively unfavorable. Therefore, microscopic studies of the tumor tissue will prove of great aid in deciding the course of treatment.

In using radium, emanation needles are implanted in and about the growth, and irradiation is maintained for from ten to fourteen days. The exact dosage depends on the size and type of the tumor.

Treatment of the Neck.—When palpable nodes are present, Roux-Berger,[24] of the Curie Foundation of Paris, advises radical operation of the side which drains the lesion and less extensive operation on the other side.

At the Memorial Hospital in New York City, it appears that, in every case, heavy external radiation of maximal intensity is used. When a palpable node is present or appears after such treatment, a complete unilateral block dissection is done with the implanation of radon seeds in all suspicious areas. Quick regards as inoperable all cases with metastatic nodes on both sides. He also looks on bilateral metastatic nodes as incurable and resorts to external irradiation as a palliative measure only. Any node which has perforated its capsule he considers inoperable.

Mixter and Grant[25] advise alcoholic injection of the third division of the fifth nerve as a palliative measure only for the relief of pain in incurable cases in which the suffering is great.

Quick[17] reports 450 cases of cancer of the tongue, 186 of which were without palpable nodes and did not develop any, seventy-three of these now being free from disease. Palpable nodes were present in 161 cases on admission, and twelve of this group are cured. In 103 cases, nodes developed, after admission, and

21. Radium Report of the Memorial Hospital, New York, 1923.

22. Roux-Berger, J. L., and Monod, O.: Traitment des épitheliomas de la langue, Bull. et Mèm. Soc. Nat. de Chir., 53:648 (May 14) 1927.

23. Quick, Douglas: Surgery and Radiation in Treatment of Cancer of Buccal Cavity, Cancer Conference, London, 1928.

24. Roux-Berger, J. L.: Le curage des ganglions du cou dans le cancer de la langue, Presse mèd., 35:881 (July 13) 1927.

25. Mixter, W. J., and Grant, F. C.: Relief of Pain in Carcinoma of Face, Ann. Surg., 87:179 (Feb.) 1928.

thirteen of this group are now clinically cured. In all, 101 cases were clinically free of disease, or 22.4 per cent.

SUMMARY

1. Cancer of the tongue is a preventable disease, the majority of cases presenting a definite history of a longstanding lesion, such as leukoplakia, syphilitic warts, atrophic glossitis, fissures, ulcers or papillomas.

2. The dentist should make a thorough and careful examination of the tongue of every patient, for he usually has the first opportunity to discover the presence of these conditions.

3. Prompt and energetic treatment should be administered to every precancerous lesion. No time should be lost. Even in the normal mouth, sharp edges of fillings, teeth, dentures, etc., should be eliminated.

4. An early diagnosis of malignancy means a better prognosis. Metastasis to the cervical and submaxillary lymph nodes is early and frequent.

5. Cases of malignancy of the tongue should be referred for treatment to the proper specialist without delay. The dentist should cooperate in carrying out the associated treatment.

127 West Eighty-Sixth Street.

ADDRESS BEFORE PAST PRESIDENTS' CLUB, AMERICAN DENTAL ASSOCIATION*

By HOMER C. BROWN, D.D.S., F.A.C.D., Columbus, Ohio

RETROSPECTION is an interesting pastime. This is especially true with those who have been the recipient of the highest honor their confrères can bestow on them, thus being provided an opportunity for real and constructive service, such as has been the privileges of all members of this club. And I assume that it is reasonable to think that, as the years accumulate, we will probably have more time for such retrospection, and no person should feel disposed to deprive any one of whatever satisfaction or pleasure may be thus obtained.

When we were young, we needed associates and friends to enjoy with us the pleasures and activities of that all-absorbing and enthusiastic age. During middle life, we appreciated those to whom we could go for counsel and advice and whom we might feel free to call on in the event that one of life's tragedies should have overtaken us. But, in later years, when the shadows begin to lengthen, we will probably have an abundance of time to spend in reverie, and it is then that we most need our true friends; yet the saddest part of all of this is that one by one our intimate associates have been passing to their reward until the list becomes greatly reduced. Edgar A. Guest very fittingly says:

You cannot know the multitude, however hard you try;
It cannot sit about your hearth; it cannot hear you sigh;
It cannot read the heart of you, or know the hurts you bear;
Its cheers are all for happy men and not for those in care.

*Denver, Colo., July 22, 1930.

Since our luncheon last October in Washington, four of our members, in the order named, have been called to their reward, as follows: Aldebert D. Peck, Lafayette L. Barber, Edwin T. Darby and John D. Patterson. Dr. Darby was President of the National Dental Association in 1883-1884 and was the recognized dean of both the Past Presidents' Club and the dental profession. His high professional attainments, his years of constructive service and his many contributions to dental progress all combined to make him an outstanding professional gentleman. John D. Patterson served two years as President, 1892-1894, and was a close second to Dr. Darby in his professional attainments and contributions. In addition to this, he had a rare personal and professional bearing which few men are fortunate enough to possess. He was a dignified and forceful speaker with a penchant for poetry and has, from time to time, thrilled this and other groups with quotations from eminent authors which were quite appropriate for the occasion.

Of my long-time friend and intimate associate, Lafayette L. Barber, who served as President in 1916-1917, I am pleased to say that he possessed many of the professional attainments and characteristics of Drs. Darby and Patterson. He was also keenly interested in organized dentistry, especially in research and legislation, and made many contributions for its advancement. As an evidence of his interest in research, he bequeathed $40,000, to be known as the "L. L. Barber Fund" to his alma mater, the School of Dentistry, University of Michigan. The only regrettable feature of this highly commendable act is that this does not become available early enough to permit his intimate associates to have the satisfaction of seeing this research program inaugurated and functioning. It was not my privilege to know Dr. Peck very intimately, as he had not been active in the American Dental Association affairs for some years. Dr. Peck served as secretary of the National Dental Association from 1900 to 1906 and was its President in 1906-1907.

I am sure all will join with me in expressing the hope that no future year will exact such a heavy toll from our group, and as a token of appreciation and respect for the memory of these gentlemen, our former colleagues, I respectfully request that we stand for a moment in silence.

THE ORGANIZATION OF THE PAST PRESIDENTS' CLUB

The Past Presidents' Club of the American Dental Association is the most exclusive dental organization in the world and necessarily of a very limited membership, which can only be attained through service in the highest official position organized dentistry can confer on its members.

As far as I am aware, the first reference to such an organization was made at the Los Angeles meeting in 1922, when it occurred to me that it would be quite appropriate for the Past Presidents to get together for a luncheon or a dinner with the thought of effecting some permanent organization. I discussed this with every Past President there and received their favorable reaction. There was so much local entertaining that it was not possible to arrange a time when all could be present. Therefore, the following year, I appeared before the Board of Trustees and presented this proposition, together with a request that if it was approved, they designate a time which would least interfere with the other affairs of the Association. This was ap-

proved and the time designated as 12:30 on Tuesday of the 1923 meeting. John P. Buckley, the President, requested that I take charge of the arrangements for this luncheon and soon thereafter I wrote a letter to every Past President advising of the approved plan for the Past Presidents' luncheon. This was held at the Hollenden Hotel. I requested that Edwin T. Darby, the senior member of our club, preside, and I was selected as secretary. Following the luncheon, Dr. Darby made an interesting address. He called on every one present for a brief talk and their responses were very appropriate for the occasion.

Our subsequent meetings have been both pleasant and profitable, and it is indeed gratifying to know that the interest in organized dentistry does not cease with the expiration of the President's term of office, as is evidenced by the fact that sixteen of the seventeen Past Presidents are present at this lunchon, and that illness is responsible for Dr. Hinman's not being present. This was one of the considerations which prompted me to think favorably of forming such an organization, since there may come a time with some of our members when there is a question as to whether they will attend the meeting of the American Dental Association, and it is just possible that the stimulation incidental to meeting with their colleagues, the Past Presidents, may be the determining factor in prompting their attendance. In this connection, I am reminded that our genial friend, Dr. Hetrick, very seriously questioned for some time whether he would attend the Washington meeting last year. It was a long trip for him, and I am convinced that if it had not been for the fact that he was scheduled to make the annual address, together with some urging from some of us, he would not have made the trip and the members of this Club would not have been permitted to hear his much appreciated message.

Further, the presence of a large percentage of our Past Presidents at these annual meetings is a stimulus to the younger members of the dental profession, and it is interesting to recall that at the time of the Minneapolis meeting, nineteen of the twenty-one Past Presidents attended the luncheon, at which time a group picture was made. Last year, we had eighteen present with only three absentees, all of whom were detained by illness and have since answered their last roll call.

THE 1910 DENVER MEETING

Just twenty years ago this week, the National Dental Association met in Denver, and it has occurred to me that it would be quite interesting to review some of the details connected with that meeting, as well as the organizational developments since then.

The Transactions of that year show that the Association had 531 members and the Southern Branch, 196. In addition to this number, the Credentials Committee reported 111 new members, and twenty-eight joined and paid dues for the current year, but did not become permanent members.

The officers of the Association for 1909-1910 were as follows: President, Burton Lee Thorpe; Vice-Presidents, William T. Chambers (West), Charles W. Rogers (East) and Thomas P. Hinman (South); Corresponding Secretary, Homer C. Brown; Recording Secretary, Charles S. Butler, and Treasurer, Arthur R. Melendy. The following officers were elected at the Denver meeting: President, Edward S. Gaylord; Vice-Presidents, Charles S. Butler (East), John W.

David (South) and Eugene R. Warner (West); Corresponding Secretary, Charles W. Rogers; Recording Secretary, Homer C. Brown, and Treasurer, Arthur R. Melendy.

Our long-time genial friend and dental diplomat, Harvey J. Burkhart, who must now assume the dignified rôle of dean of our Past Presidents' Club, was chairman of the Executive Council, and the late John D. Patterson was chairman of the Executive Committee. Both of these distinguished gentlemen had served in their respective capacities for several years.

Mark F. Finley was chairman of the Committees on Department of Public Health and Pharmacopeial Convention; John V. Conzett was chairman of the Educational Council; L. L. Barber was chairman of Section 2; William Carr, chairman of Section 3; Henry C. Ferris, chairman of the Committee on Scientific Research. C. N. Johnson was a member of the Committee on Low Patent; Frank O. Hetrick and I were functioning as chairman and secretary of the Committee on State and Local Societies. Charles McManus was chairman of the Committee on History, which consisted of twelve members of whom only two are living, A. C. Fones and W. R. Wright.

Dr. Burkhart and I are the only living members of the Executive Council listed in the 1910-1911 Transactions, and Don M. Gallie, Mark F. Finley and C. M. Work are the only living members of the Executive Committee of fifteen.

Further, in reviewing the list of the committeemen for that year, you cannot fail to be impressed with the fact that time has demanded a heavy toll from those active in the Association affairs of two decades ago.

REORGANIZATION OF THE NATIONAL DENTAL ASSOCIATION

William Carr, in his address as President of the National Dental Association at the Boston Meeting in 1908, made a recommendation that the Constitution and By-Laws be amended so that every member in good standing of each state dental society would be admitted to the meetings of the Association. R. Ottolengui, at a later General Session, presented for consideration a copy of a proposed Constitution and By-Laws which had been drafted along similar lines to that of the American Medical Association. On motion, this was referred to a Committee on Revision of the Constitution and By-Laws, consisting of John D. Patterson, B. Holly Smith and S. A. Hopkins. This committee made a report the following year at the Birmingham meeting, but their recommendation did not go far enough to satisfy the progressive element in the profession, and their report was not approved, but was received, and the committee instructed to print it in pamphlet form and send a copy to each member. V. E. Turner, in his address as President, discussed this question and, as Corresponding Secretary, I was authorized to correspond with the officers of the state dental societies and, where possible, visit them as the official representative, presenting the claims and advocating the interest of our national association.

My report, submitted at the Denver meeting the following year, was none too encouraging, as no particular interest was evidenced by the various state dental society officers in becoming affiliated with the national organization. However, at this meeting, Dr. Ottolengui and I were added to the committee, and having been selected Secretary, I promptly began an

aggressive campaign, which was loyally supported by Dr. Ottolengui, and to a lesser degree by Dr. Patterson, until finally most of the obstacles were overcome and today the American Dental Association, the successor of the National Dental Association, has a membership in excess of 36,000. Further, the percentage of our membership, as compared to the total number eligible, is probably higher than most other professional groups, and we have a far larger percentage in attendance at our meetings than most of the other national organizations. For instance, the recent meeting of the American Medical Association, held in Detroit, had a total registration of 5,016 members out of a membership of approximately 100,000. This comparative data covers a period of two decades, but the most of this was accomplished within the first ten year period of this time.

In closing, may I not express the hope that each of you will continue all your favorable professional contacts and render such service as may be requested of you, from time to time, by the organization which has made possible your membership in this club? Further, may I not suggest that you look for the "bright side" of the problems confronting you and our Association and have confidence in and respect for your fellowman, since through such a generous attitude toward men and affairs, you may be privileged to meet with your friends and club colleagues longer than would otherwise be possible. Then, when the evening shadows gather, it will undoubtedly be a source of satisfaction to feel that you have made at least some small contribution in raising our professional standards, which, in its final analysis, provides afflicted humanity with a more efficient dental service. Such meritorious efforts are usually recognized and appreciated, even though it frequently requires a lapse of time before full recognition is accorded the individual. The following lines from Kipling seem most appropriate for those who have rendered a worthwhile service for the benefit of mankind:

When Earth's last picture is painted, and the tubes are twisted and dried,
When the oldest colours have faded, and the youngest critic has died,
We shall rest, and faith, we shall need it—lie down for an aeon or two,
Till the Master of All Good Workmen shall set us to work anew!

* * *

And only the Master shall praise us, and only the Master shall blame;
And no one shall work for money, and no one shall work for fame;
But each for the joy of the working, and each, in his separate star,
Shall draw the Thing as he sees It for the God of Things as They Are!

609 Hartman Building.

THREE-QUARTER ATTACHMENTS FOR POSTERIOR BRIDGES

By F. D. VOIGT, D.D.S., Salem, Ore.

INLAY forms may be classified similarly to the brakes of an automobile, namely, the internal expanding and the external contracting type.

Considering the inlay as the brakeband and the tooth structure as the brakedrum, all mesioclusal, distoclusal, etc., inlays are of the internal expanding type; the inlay being on the inner side and the tooth structure on the outer side, the outer surface of the inlay, or brakeband, offering the resistance to removal by contact with the inner surface of the tooth structure, or brakedrum and the cement forming the contact.

All Carmichael, three-quarter crowns, etc., are of the external contracting type, the tooth structure being on the inner side and the inlay on the outer side, the inner surface of the inlay, or brakeband, offering the resistance to removal by contact with the outer surface of the tooth structure, or brakedrum.

In the preparation of most posterior teeth for a three-quarter crown, the lingual half of the tooth, with extensions buccally on both mesial and distal surfaces, is the portion generally prepared for the crown, although, in some cases, use of the buccal half, with extensions lingually on the mesial and distal surfaces, is indicated, the two retention grooves being placed on the mesial and distal surfaces.

In making a three-quarter crown, I prepare the mesial or distal half of the tooth, whichever the case may be, for the inlay, placing the two retention grooves on the buccal and lingual surfaces.

These attachments are indicated on all posterior teeth used for bridge abutments where the contact surface of this tooth with the adjoining tooth is sound.

If a lower first molar is missing, and we wish to place abutments on the second bicuspid and the second molar, supplying the first molar, the preparation for the second molar is as follows: With a small thick-edged carborundum stone in the straight handpiece, the mesial half of the occlusal surface is reduced, being extended distally to a point slightly distad from the buccolingual groove, the depth being equal to the thickness of the gold desired at this point, and the reduction being made to follow the shape and outline of the original cusp formation.

With a three-fourths inch thin carborundum disk in the contra-angle, the mesial surface and the mesial half of the buccal and lingual surfaces are reduced, the disk being held parallel with the long axis of the tooth.

With a square-end mounted carborundum stone in the contra-angle, the reduction of the mesial half of the buccal and lingual surfaces is finished to a point about 1 mm. distad from the buccolingual groove and gingivally from a point just within the gingival border.

These surfaces should be almost parallel, slightly converging toward the oc-

clusal aspect so that the inlay will draw.

With a square-end fissure bur of proper size in the contra-angle, grooves are placed parallel with the long axis of the tooth and to lines parallel to each other in each buccal and lingual axial wall at a point just mesiad from the remaining distal wall, as in Figure 1.

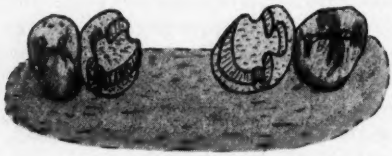

Fig. 1.—Linguoclusal view.

If the cusps are worn, no further preparation is needed except the beveling of all margins.

Generally, the preparation will have to be extended to include the distal groove in order to prevent decay, as in Figure 1.

In a preparation of this type, access may be gained more easily than with any other three-quarters type.

The preparation for the second bicuspid is quite similar, being made on the distal half, the exception being that the retention grooves on the buccal and lingual surfaces are not placed so near the center, the buccal groove being placed distad from the center of the buccal surface, while the lingual groove is placed mesiad from the center of the lingual surface, but not so near to the adjoining tooth that the surface is not self-cleansing.

Fig. 2.—Occlusal view of bridge.

These type abutments are also indicated on upper posterior teeth, the added advantage on bicuspids being that the unsightly appearance of gold on the mesiobuccal surface is eliminated.

An occlusal view of the bridge is shown in Figure 2.

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C. N. JOHNSON, Editor

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Editorial

PANEL DENTISTRY

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION has refrained till now from an editorial discussion of the very insistent and perplexing question of panel dentistry for the reason that there seemed so much confusion concerning it that it was difficult to formulate a logical premise on the situation. Even now we have only the vaguest ideas as to the probable ultimate developments of this much mooted question, but there are at least a few observations that should be made at this time.

Of one thing we may be sure, that panel dentistry will never be forced on this country without the most virile and bitter opposition that has ever been engendered in the history of our profession. We shall never tolerate the system of panel dentistry as operated in some of our European countries today. England is a sad example. It is only in line with the general dole system of England and the

dole has been most pernicious in its operation. It is not a time for temperate speaking. The demoralization of the dole has been the one outstanding ulterior development of our postwar activities. Not that England was to blame—not that any country was to blame. There was just one thing that was to blame for all this hideous misadventure of the past few years, and that thing was WAR.

England after the War was confronted with the spectacle of 6,000,000 men suddenly dumped on the British Isles, only to find their jobs taken by women; taken legitimately and because of the dire necessity of the situation. With what result? Only one alternative—government support through the medium of the dole or the hydra head of revolution. England accepted the dole, as needs she must, and thereby fastened on herself the most distressing and demoralizing system that ever took a nation by the throat and choked the life currents of legitimate initiative out of the manhood of the people.

Columns might be written on the demoralization of the dole; and the whole wretched debacle will never be fully realized till the aftermath shall, in the fullness of time, be cleared away. The dole began as an emergency measure, and panel dentistry is only a piece of the same emergency. It is no more fundamentally right than is the dole. It stifles ambition and individuality as does the dole, and it inevitably tends to the same lowering of standards.

This nation will never submit to the dole or to panel dentistry. How much of a struggle may be necessary to suppress it is only conjectural at present, but the ultimate result is without the shadow of a doubt. The initiative of the American people will never stand for such a system. It is too subversive of constructive effort, and too blighting in its effects.

Mayhap there shall be some readjustment of existing lines of thought; mayhap there shall come to us in the days to come—in the near days to come — a greater consecration to the principle of a better and more equitable professional service. Mayhap we shall see a more humanitarian approach to the problem of adequately providing for the masses whereby the teeth of the poor, and par-

ticularly the teeth of children, are assured of a more acceptable service.

In these matters we are more or less groping in the dark, but it is at least something that we are groping and not standing idly by with our backs turned, or our heads hidden in the sand. Today we are concerned chiefly with the finding of facts connected with our dental problems, and not till we know more of the facts can we hope to offer a promising solution. In addition to the securing of facts we need alertness of a peculiar order. We need to protect ourselves from the mirage of the false reformer or the miasma of the self-seeking sensation monger.

There is a constant tendency in these latter days to tear down instead of to build up. We seem prone to flout all of the splendid and fundamental traditions of the past, and to scurry to the shelter of the faddist and the disruptionist. It is a fight between the brilliant forces of initiative and constructive effort, and the dull monotony of mediocrity and stagnation.

And in this fight we must enlist the support of every loyal and forward looking man and woman, to the end that the principles of equity and justice shall not be dragged in the mire but that we shall be given our legitimate place in the sun.

Panel dentistry is fallacious in theory and pernicious in practice, and it must never be given a foothold in America. Let us gird our loins for the coming battle, if battle there is to be, and let us refuse to yield one jot or tittle of the precious heritage of our professional past—a heritage won for us by nearly a century of sanctified service.

COUNCIL ON DENTAL THERAPEUTICS

FORHAN'S FOR THE GUMS— NOT ACCEPTABLE FOR A. D. R.

The Council has authorized publication of the following statement.

SAMUEL M. GORDON, *Secretary.*

THE promulgation of the slogan "A clean tooth never decays" started a competition in which copywriters of toothpaste advertising vied with one another in the attempt to invent slogans and in uncritical science. Affairs had reached the pass where even those dentists who viewed this competition humorously felt that some of the ridiculous claims and counterclaims were reacting to the benefit of neither the profession nor the public. From this competition, there has sprung up these slogans: "four out of five," "the dentist's dentifrice," "the film removing toothpaste," "the danger line," "more than a dentifrice," "corrects acid mouth," "three shades lighter," or what have you.

An examination of dentifrice advertising, regardless of the nature of the product, brings out one common trait — the element of scientific honesty was conspicuous by its absence, or facts were distorted, unduly emphasized or pruned as the needs of the copywriter dictated. Small amounts of astringent or antiseptic drugs were given virtues that not even the none too critical student of pharmacology would admit; pepsin was given a prominence that made the biochemist smile; milk of magnesia gained a new reputation as a neutralizer of "acid mouth," and soap brought to the public "surface tension," and so on *ad nauseam*. The claims used to bolster up the slogans were based on evidence no more critical.

A few dentifrice makers were content to rest their sales appeal on the reasonable ground that a dentifrice cleans; others ranged their pretensions from a correction of "acid mouth" to the inclusion of pyorrhea and other deep seated dental conditions, or even to systemic conditions that were not even remotely related to the expected functions of a dentifrice.

As the competition unfolded, copywriters played with the theme that the "mucin film" must be removed, until the public were trained to believe that here were harbored those insidious bacteria that generate tooth dissolving acids and whose presence leads to caries, pyorrhea or even rheumatism, and that the whole of dentistry revolved around the chase for these not entirely recognized micro-organisms.

These themes were father to those toothpastes containing small amounts of pepsin, "fruits acids," or alkaline substances. The fact that neither pepsin nor the fruit acids combined in a toothpaste digested or coagulated the film or that

strong abrasives are contraindicated for daily use did not act as a deterrent to the misleading advertisement. Then, too, there was the alkaline toothpaste, notably milk of magnesia dentifrices. Little did it matter to the advertisers that the scientific evidence indisputably showed that alkali or acids do not and cannot be expected to change the reaction of the mouth for consequential periods; or that the older idea that the normal reaction of the saliva is alkaline was based on a fundamentally faulty technic. They overlooked the circumstance that the fluids of the body retain to a remarkable degree an almost constant reaction. Even stronger yet was the "ballyhoo" that acid dentifrices would overcome "acid mouth" by stimulating the salivary glands to pour out an alkaline saliva. The circumstance that saliva is a highly buffered liquid could not be allowed to curb advertising imagination, or the fact that the question of the relation between the volume of saliva and caries, for example, is still an unsettled and perplexing question. Montgomery rightly states: "The experiment described indicates that one must look to some other agent than the saliva as the main factor in the preservation of the teeth.[1]

Strange as it may appear to readers who have not followed dentifrice advertising, the salivary theme was introduced for the edification of the consuming public by the makers of a dentifrice who were in large part responsible for the litmus paper test and the scientific skullduggery that went with it.

Even more harmful than this competition to bamboozle the public by a distortion of scientific knowledge was the appearance of that school of advertisers who gave to their toothpaste curative virtues extending from mere stimulation to prevention of gingivitis and of conditions included in the term pyorrhea. A perusal of this group of advertising claims shows that they had no more scientific support than being medicated with extremely small amounts of some drugs, such as zinc chlorid, phenols or phenols of the naphthalene series; or iodin containing toothpastes. All this despite the evidence that a dentifrice could be expected to do nothing more than make the task of brushing the teeth a little more pleasant. But the straw that may be said to have broken the camel's back was the inferential promise of the makers of milk of magnesia toothpaste that its use "may save you a bad case of rheumatism."

In short, these advertising writers are willing to concede little or nothing to diet and constitutional make-up or to the experience acquired by the dental profession through long and careful training. They do make one apparently generous gesture as a palliative for their misleading claims: "See your dentist twice a year," but in the meantime much depends on the toothpaste—meaning, of course, the subject of a particular advertisement. It is readily apparent that dentifrice advertising claims do not readily lend themselves to scientific discussion, for such a discussion must be governed strictly by the weight of available evidence, whereas dentifrice advertisers have not thus limited themselves.

It was a consideration of this abuse of the feelings of the public and the profession in toothpaste advertising that led the Council to give its immediate attention to the problems involved in the public advertising of the dentifrice. The claims and counterclaims that a dentifrice was more than an aid in cleaning the teeth do not,

1. Montgomery, Effect on the Teeth of Total Absence of the Salivary Secretion, J. A. D. A., 17:1338 (July) 1930.

the Council holds, react to the public or to professional benefit. The Council, therefore, has adopted for the time being an extremely liberal view, compatible with consistency, regarding the composition of this class of products. It has, as a consequence, agreed to accept dentifrices for its list, A.D.R., provided: claims are strictly limited to their efficacy as an aid in the hygiene of the oral cavity and particularly to their mechanical cleansing properties; no therapeutic, chemical or bacteriologic claims are made or inferred in their exploitation; therapeutically suggestive names are not used as a brand name; the brand name is not indicative of a component which does not possess proven therapeutic properties or other inferred properties implied in the name, and there is no conflict with the rules of the Council. The provisions in reference to proprietary names will not be retroactive.

These provisions have been before the public for almost a year. They set for the first time a reasonable standard for dentifrice advertising. Some manufacturers have requested the Council to examine their products and advertising. Three have been made acceptable for the time being, but others evidently feel that truthfulness in advertising is too high a price to pay to make their product acceptable. Can it be that profits are placed before the interests of the public?

One of the more serious offenses against decency in this respect has been the advertising put out over a stretch of years for Forhan's Pyorrhea Astringent, Forhan's for the Gums or Forhan's, as the product has been designated at various periods. In 1920, Forhan's for the Gums was claimed to be the dentifrice that "checks pyorrhea," with a slogan "four out of five have it." The formula of R. J. Forhan, D.D.S., was presented thus: "Forhan's for the Gums will prevent pyorrhea—or check its progress if used in time and used consistently. Ordinary dentifrices cannot do this." Yet no records of the ability of R. J. Forhan, D.D.S., to prevent or check pyorrhea by his dentifrice are found in the dental literature.

Before this time, in 1915, the preparation was boldly designated as "Forhan's Pyorrhea Astringent; the formula of R. J. Forhan, D.D.S., specialist in diseases of the mouth." R. J. Forhan, D.D.S., appears to be better known for his ability in commercializing a toothpaste than as a specialist in diseases of the mouth. Inquiries directed to a former president and secretary of the First District Dental Society of New York, where R. J. Forhan was reputed to reside, brought the information that R. J. Forhan has never been a member of that society.

It is but fair to state that, as time went on, the preventive claims relative to pyorrhea were modified. In 1928, it was reported that the National Government was preparing to bring action against the Forhan Company for alleged adulteration and misbranding.[2] Of late, the slogan "four out of five" has been altered by addition of the significant *may*, but nevertheless the inference that Forhan's is more than an ordinary toothpaste and that it will prevent pyorrhea is still apparent. Statements such as the following are put forth in public advertising.

And today there are people who do not think of using Forhan's until their mouths are beyond the help of ordinary toothpastes.

Do not make the mistake of thinking Forhan's is only a pyorrhea treatment.

It is far better to avoid disease than to treat it after it develops. The use of this scientific dentifrice will help you to keep the mouth of youth well into middle age.

2. Tr. A. D. A., 1928, p. 127.

Such assertions denote therapeutic and preventive claims for which definite, adequate, carefully controlled evidence should be presented, which has not been done to date.

Such statements in advertising as the "dentists' dentifrice" is obviously a figment of a copywriter's imagination. The American Dental Association has not given authority for this statement. The progressive dentist knows that different individuals may require dentifrices of different kinds—if a dentifrice should be used at all. The claim "prepared for the prescription of the dental profession," while possibly literally true, is in the same category as the implication in the phrase "dentists' dentifrice." The prescription part is not clear when anyone can purchase it at most drug or cosmetic counters without a prescription signed by a dentist.

How, without adequate evidence for the claims or statement of composition, would progressive dentists prescribe this preparation? For the formula of Forhan's is admittedly secret. A request for information concerning the composition brought the enlightening information that the formula was not made public.

Because of the number of inquiries concerning the product, the A.D.A. Bureau of Chemistry examined the product. The report of the Bureau follows:

FORHAN'S FOR THE GUMS

Twelve (12) original packages of Forhan's for the Gums (Forhan Co., New York), price 45 cents each, were purchased on the open market for examination.

The following appeared on the carton enclosing the individual tube of paste:

Contains no alcohol.
Formula of R. J. Forhan, D.D.S.

The following appeared on the tube:

Prepared for the Prescription of the DENTAL PROFESSION.
Before brushing teeth, brush and massage the Gums as enclosed circular directs.

A number of cartons were opened, but "enclosed circulars" were not found.

Statements appearing in public advertising indicate that Forhan's for the Gums is compounded with Forhan's Pyorrhea Astringent.

Previous examination of Forhan's Pyorrhea Astringent[3] indicated that essentially a similar solution could be duplicated by dissolving zinc chlorid, U.S.P.X., 49.6 gm.; cobalt nitrate hydrated, 1.4 gm.; glycerin (U.S.P.X.), 18 c.c.; hydrochloric acid, dilute 5 c.c., and adding sufficient water to make 100 c.c.

As one advertising feature of "Forhan's for the Gums" appears to be the content of "Forhan's Pyorrhea Astringent," the following examination was restricted to the determination of zinc, cobalt and chlorid in the preparation.

Qualitative determinations indicated the presence of soap, carbon dioxid, calcium, glycerin, chlorid, starch, reducing substances, after hydrolysis, and zinc.

Cobalt was not found by colorimetric tests capable of furnishing a positive reaction for amounts of cobalt as low as 0.02 mg. when applied to samples of approximately 10 and 15 gm. of the toothpaste.[4]

3. J. A. D. A., 16:1940 (Oct.) 1929.
4. Yoe, J. H.: Photometric Chemical Analysis, Vol. I, Ed. 7, New York: John Wiley Co. p. 173, 1928.

Zinc was determined by eventual precipitation as zinc ammonium phosphate. The results appear in the accompanying table:

Wt. Forhan's Used Gm.	$ZnNH_4PO_4$ Obtained Gm.	Zinc Gm.	Zinc Per Cent	Zinc Chlorid Calculated Per Cent*
75.9369†	0.1467	0.0537	0.070	0.152
74.6031†	0.1503	0.0550	0.074	
75.9227†	0.1492	0.0547	0.072	0.146
74.8200†	0.1392	0.0507	0.068	

Wt. Forhan's Used. Gm.	AgCl Gm.	Chlorin (Cl^-) Gm.	Chlorin (Cl^-) Per Cent.	Zinc Chlorid Calculated Per Cent*
1.6159‡	0.0062	0.0015	0.095	0.185**
1.6362	0.0065	0.0016	0.098	

†Contents of one tube.

*Average of two determinations.

‡Aliquot portions used.

**The slightly higher value for zinc chlorid calculated from the chlorid determination is not surprising in view of the fact that liquor zinc chlorid contains a slight excess of hydrochloric acid.

How a toothpaste containing a small amount of zinc chlorid will prevent pyorrhea and keep gums healthy has not been made clear by the Forhan Company. Furthermore, the Forhan Company has not shown by adequate evidence the necessity for the daily medication of normal teeth and gums with a toothpaste containing a small amount of zinc chlorid. The extremely liberal specifications of the Council for dentifrices for the time being permit the inclusion of metallic astringents, but no claims based thereon should be made.

In view of the foregoing, the Council declares Forhan's toothpaste unacceptable for A.D.R. because it is a toothpaste of secret composition (Rule 1) and it is marketed with unwarranted therapeutic claims (Rule 6), with an apparent disregard for the limited usefulness of toothpastes.

The Council desires to point out that, in view of the available evidence, a dentifrice can be expected to do nothing more than aid in the mechanical cleansing of the teeth. The evidence is against the view that dentifrices can be expected to act as germicidal agents, as neutralizers of acid mouth, as film removing agents or as therapeutic agents.

ACCEPTED DENTAL REMEDIES

The following dentifrice has been accepted as conforming to the provisions for dentifrices of the Council.

SAMUEL M. GORDON, *Secretary.*

DENTOSAL DENTAL CREAM.—Composition: Each 100 gm. contains sodium carbonate (Na_2CO_3), 3.7 gm.; sodium bicarbonate ($NaHCO_3$), 45.8 gm.; glycerin, 32.1 gm.; soap, 4.3 gm.; water, 12.7 gm.; flavoring, 1.4 gm.

Claims: **The manufacturer has agreed to make no claims except that it is a soluble cleansing agent; and has agreed to discontinue the use of testimonials of Swedish dentists, which were formerly used in advertising. No chemical, therapeutic or bacteriologic claims are made.**

Manufacturer: Aktiebolaget Dentosal, Stockholm, Sweden. General agent for U. S. A., Tage Samsioe, 255-B Shawmut Avenue, Boston, Mass. U. S. Patent 1460039 (June 26, 1923). U. S. trademark 187986.

CHANGE OF DESIGNATION FROM ACCEPTED NONOFFICIAL DENTAL REMEDIES TO ACCEPTED DENTAL REMEDIES FOR THE OFFICIAL LIST OF THE COUNCIL ON DENTAL THERAPEUTICS

The original plan of the Council regarding the publication of a list of acceptable remedies was to furnish in one place a list of acceptable nonofficial remedies, and in another place a list of useful official drugs with comments thereon. Since the original announcement, the desirability of publishing in one book both official and nonofficial accepted drugs, irrespective of source, has become apparent. This book is now in the course of preparation, and more definite announcement concerning it must be deferred to some future date. Meanwhile, those submitted articles accepted for the list will appear in THE JOURNAL under the heading "Accepted Dental Remedies" instead of "Accepted Nonofficial Dental Remedies" as heretofore.

SAMUEL M. GORDON, *Secretary*.

BUREAU OF CHEMISTRY

MORE MISBRANDED NOSTRUMS OF DENTAL INTEREST*

VICINE

The Vicine Products, Memphis, Tenn., shipped in July, 1929, into Alabama, a quantity of Vicine that was declared misbranded.

Analysis of a sample by the government chemists showed that it consisted essentially of iron sulphate, small amounts of phosphate, calcium salts and sulphuric acid, and water. Bacteriologic examination showed that the article was not germicidal.

The claims that it is a powerful antiseptic, a powerful germicide and prophylactic; that it is a remedy for Pyorrhea, Sore and Bleeding Gums, Sore Throat, Diseased Tonsils, Halitosis, Acid Mouth were declared false and misleading. (Notice of Judgment, 17077; issued, December, 1930.)

NOZOL

The Nozol Co., Inc., Etna, Pa., shipped in August and July, 1929, a quantity of Nozol into Maryland.

Analysis of a sample by the government chemists showed that it consisted essentially of a mineral oil containing camphor, oil of peppermint and menthol, colored with a red dye.

The statements regarding the curative or therapeutic effects of Nozol, that it "keeps the nose clean and healthy," "Nozol is today recognized by physicians, hospitals and specialists as the foremost preparation for the treatment of general nasal troubles," "Sinus Trouble relieved with Nozol," among others were declared false and fraudulent, since the article contained no ingredient or combination of ingredients capable of producing the effects claimed. In March, 1930, judgment of condemnation and forfeiture was entered and the court ordered that the product be destroyed. (Notice of Judgment, 17081; issued, December, 1930.)

TANNA-MENTHOL

The Tanna-Menthol Co., Inc., Enid, Oklahoma, shipped in December, 1929, into Missouri, a quantity of Tanna-Menthol that was declared misbranded.

Analysis by governmental chemists showed that it consisted essentially of potassium iodid, menthol, iodin, tannic acid, glycerin, alcohol and water.

Misbranding was alleged in that a correct statement of the amount of alcohol did not appear on the label, and further, that the following claims on the label: For Sore Throat, Pyorrhea, Nasal Catarrh, Trench Mouth, Tanna Menthol kills germs, gargle for sore throat, tonsillitis, trench mouth were false and fraudulent. In February, 1930, a decree adjudging the product misbranded, and that the product be released to the claimant on the execution of a bond in excess of $100.00 and conditioned in part that it be relabelled under the supervision of the department of agriculture. The court ordered that the costs be paid by the claimant.

G. G. GERMICIDE

Rose Rockwood, of Belgrade, Me., shipped in October, 1929, in two consignments into Massachusetts, a quantity of G. G. Germicide.

Analysis by government chemists showed that it consisted essentially of formaldehyd, extracts of plant drugs including sassafras, alcohol and water; and bacteriologic examination showed that it was not antiseptic in the dilutions recommended on the label.

The claims that in the strength used this was a germicide were false and misleading and the court ordered that judgment of condemnation and forfeiture be entered; and

*Abstracts of Notices of Judgment under the Food and Drugs Act.

that the product be destroyed. (Notice of Judgment, 17086, issued, December, 1930.)

DA-LEE MOUTH WASH and DA-LEE TOOTH PASTE

Da-Lee Chemical Co., Inc., Baltimore, Md., shipped in November, 1929, to the District of Columbia, a quantity of Da-Lee Mouth Wash and Da-Lee Tooth Paste, which was declared adulterated and misbranded.

Analysis by the governmental chemists showed that the Da-Lee Mouth Wash consisted essentially of sodium bicarbonate, small amounts of glycerin, benzoic acid and volatile oils including anise, peppermint, cassia oils, and methyl salicylate, alcohol (36.1 per cent) and water; and the Da-Lee Tooth Paste consisted essentially of calcium carbonate and small amounts of glycerin, thymol, menthol, eucalyptol and methyl salicylate, and bacteriologic examination showed that the De-Lee Mouth Wash was not antiseptic in the dilutions recommended on the label, and that the Da-Lee Tooth Paste was not antiseptic.

The claims that "Da-Lee Mouth Wash and Da-Lee Tooth Paste provides a complete prophylactic treatment of the whole mouth; Da-Lee Mouth Wash is a powerful antiseptic several times stronger than required by the U. S. Government, and Da-Lee Tooth Paste contains . . . Antiseptic ingredients; Da-Lee Mouth Wash and Da-Lee Tooth Paste provides a complete prophylactic treatment of the whole mouth" were false and misleading for the mouth wash was not antiseptic in the dilutions specified and the tooth paste was not antiseptic.

Misbranding of the Da-Lee Mouth Wash was further alleged in that the following statements: Sore Throat, Pyorrhea, recommended by eminent dentists and physicians efficient in their treatment for receding or bleeding gums, canker sores or any unhealthy condition of the mouth were false and fraudulent.

The court ordered that the products be delivered to a public institution to be used in such manner as would not violate the Federal Food and Drugs Act. (Notice of Judgment, 17089; issued, December, 1930.)

SUCCESS COLD TABLETS

The Walgreen Company, Chicago, Ill., shipped in October, 1929, into Missouri, a quantity of Success Cold Tablets which was declared misbranded.

Analysis by federal chemists showed that the tablets contained acetanilid, an extract of a laxative plant drug, and were flavored with methyl salicylate.

The claim regarding the curative or therapeutic effect "For the treatments . . . La Grippe . . . For relieving . . . La Grippe, etc. . . . In severe cases," were false and fraudulent. In February, 1930, the court ordered judgment of condemnation, and forfeiture was entered and the court ordered that the product be destroyed. (Notice of Judgment, 17094; issued, December, 1930.)

SELSO HEADACHE POWDERS

The Standard Manufacturing Laboratories, Macon, Ga., shipped in July, 1928, into Alabama, a quantity of Selso Headache Powders, which was declared misbranded.

Analysis by government chemists showed that the powders contained acetylsalicylic acid, acetphenetidin and caffein.

Misbranding was alleged in that the following statements in the labeling were false and misleading: "Safe" "Selso Headache Powder—is composed of . . . ingredients . . . to insure safety . . . and harmless," whereas, the article contained acetylsalicylic acid, acetphenetidin and caffein.

In October, 1929, judgment of condemnation and forfeiture was entered, and the court ordered that the product be destroyed. (Notice of Judgment, 17095; issued, December, 1930.)

BUREAU OF DENTAL HEALTH EDUCATION

POINTS OF COMMON INTEREST TO THE DENTIST AND THE PEDIATRICIAN*

By HENRY NIBLACK, M.D., Chicago, Ill.

THAT this paper is concerned with the work of the pediatrician at once limits its scope to the period of childhood; the period, as ordinarily accepted, which begins with birth and ends with adolescence or with the completion of grammar school. In this discussion, I am including the intra-uterine stage of development, because of its influence on the child's future health. As such varying aspects of development and behavior are presented at different ages, we divide the period of childhood into the following phases: the prenatal; infancy, from birth to 2 years; the preschool, from 2 to 6 years, and the school, from 6 to 14 years. This more or less artificial division is convenient for organization and study, but, at no time, with the exception of birth, is there a sharp point of division; rather, there is a gradual shading of each phase into the next.

The dental and medical professions are the essential branches of the art of healing and prevention of disease. As yet, healing is the major activity. A pathologic condition, with attending pain, handicap or embarrassment, inevitably forces the sufferer's attention to himself, with the result that he seeks relief through the dentist or physician. To meet this demand and, to a lesser extent, to earn a livelihood and to answer the urge of professional ambition, the members of these professions are compelled not only to follow this type of work but also to progress with the advancements in this field. The immediate and substantial rewards may be expressed in terms of gratitude on the part of patients, financial profit or professional success.

In the field of prevention, this tangible allure is largely lacking. There is not the stimulation that comes from a difficult and spectacular piece of work, quickly and successfully accomplished. It takes an idealistic and forward-looking temperament to find satisfaction in the anticipation of the benefits of a service performed in the present which will not accrue until some future time, perhaps generations to come.

Yet constructive health work means prevention through the slow process of education. Already, there is a wholesome interest on the part of laymen and altruistic lay organizations in this field of medicine. As this interest increases, more real and immediate will be the rewards to members of the professions interested in this type of endeavor. It is unfortunate that, after the spark of

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 23, 1930.

some essential prophylactic measure is struck in the scientific laboratory, it is the lay organization which is fired to spread it to the general public. The result, through misapplication by unskilled forces, is often a detriment to both the procedure itself and the welfare of the public. We, the professional groups, well-meaning though we may be, reap the criticism. The lay group must look to us for leadership and guidance in the application of methods of disease prevention, and unless we maintain that leadership, medicine and dentistry will continue to be forced more and more into paternalistic patterns.

Granted that we are the agents of prevention and healing, our obligation assumes a twofold function; first, as related to the individual or the private patient, and, secondly, as related to the community or the activities of public health. How are we dentists and pediatricians carrying out these two duties to childhood in its several phases? Let us take stock, as it were, of our shortcomings and successes, to see wherein there may be room for improvement. I should like to begin with the prenatal period and run through the ages groups as I gave them above. Historically, the development of child welfare, like all other humanitarian efforts, has been governed by the demands of the most apparent or obvious necessity.

Following a historical sequence, we find that the first formal efforts in the field of child welfare began in the first half of the nineteenth century, in the school group. The emergency situation, to the health workers of that time, was the inroads of contagious disease on the attendance of children at school. In order to function properly, schools must remain open, and the child, to obtain the maximum benefit from the school, must be in regular attendance. Inspection of school children for contagion and the barring from school of cases found were instituted. Schools were no longer closed because of sweeping epidemics of contagious disease.

It was true that the pupils' attendance improved; yet many failed to make satisfactory scholastic progress. The next obvious conclusion was that the cause of much of this retardation might be due to physical defects in the lagging pupil. Again, the necessity called for a remedy, and examinations for physical defects, with follow-up for correction, were inaugurated.

At this time, the dental profession entered the field of prevention with a well-developed program of mouth hygiene. To these medical and dental programs in the schools, there have been grafted related child welfare activities such as behavior clinics, vocational guidance and social adjustment; resulting in as comprehensive a health service as is rendered at any time during the childhood period. The danger is that, in all these ramifications, we may lose sight of the child himself. He becomes merely a case, in one or more of these numerous specialties. Only through perfect cooperation and coordination of these various forces can the best health results be obtained for the child, to say nothing of facilitating the work of the various groups.

The next great advancement in child welfare was in the care of the infant, the immediate necessity being the appalling death rate in this age group. The reduction of the infant mortality rate during the last quarter of a century is one of the great accomplishments of modern medicine. During the period of infancy, the dentist must assume an attitude of expectancy, hoping that later,

as children and adults, they will come to him in as good oral condition as possible. If physicians, especially obstetricians and pediatricians, did their full duty from the standpoints of diet and habit-training in the prenatal and infancy periods, there would be no need for reparative dental service later on. Under present conditions, the dental profession promises to continue to wax busy and prosperous. Bearing the main responsibility of the welfare of the child's mouth during the first two years of life, there are certain things which the pediatrician must very definitely look after. He takes over the care of the infant at birth, hoping that the latter is endowed at least with a foundation of healthy tissue. It now becomes his responsibility to throw about the infant such conditions as will permit and encourage further development in a normal healthy manner. The primary requisite for healthy teeth is correct diet, which *par excellence* is breast milk from a properly fed mother. Breast milk not being obtainable, we must furnish to the infant a satisfactory substitute.

We also seek to endow him with a set of correct health habits. Through these habits, there is established in the young individual an attitude that recognizes and carries out the correct procedure in any health situation. We cannot teach him to brush his teeth at this early age, but we can give him "form," as it were; that is, an adaptability to a regular routine which works in the interest of his health and well-being.

We wish to present these children to you not only with well-nourished teeth but also with mouths as handsome and symmetrical as possible. Such pernicious habits as thumb sucking, lip and tongue sucking, improper sleeping postures and all other evil practices which tend to deform the mouth are guarded against. In the meantime, the mothers are taught the importance of caring for these baby teeth, not only because they are essential to the infant's and young child's present health and welfare, but also because of their influence on the permanent teeth. An effort is made to impress on her the fact that it is never too early to begin caring for the baby's teeth. Some of us, at least, teach that a child is never too young to be taken to the dentist, that it is a great misfortune to allow decay to progress until the teeth have to be extracted.

In the public health field, the infant welfare conference is one of the leading activities. I believe that a dental consultant in connection with this service would prove of the greatest value in educating parents to the necessity of dental care, invisible though the teeth may be at this early age.

Following, as we are, a historical sequence in the development of child welfare and pointing out how necessity at various times led to the extension of this work, we are brought next to the preschool, or 2 to 6 year old, children, until recently the submerged and neglected group, about which very little was known. Attention was focused on the preschool child because of what he was as a school child. Our inspections and examinations showed that a great number of school children were physically defective. The logical question was, and still is, why set up these elaborate school health programs to find and care for conditions which could be prevented before the child enters school? The great difficulty is the accessibility of the preschool child. There is no organization such as the school which brings them together in large groups in which they can be studied and rendered such educational and health service as they so urgently need.

In answer to this need of a means of reaching this age group, there has grown up a new institution known as the nursery school, more than a day nursery and not quite a kindergarten, a modified and exalted combination of both. Health is given equal importance with education. The children have the advantage of regular medical and dental inspection and care, but the closest supervision is given to the diet and habits as related to health, including, of course, mouth hygiene. Certainly, these children are not going to contribute to that large group of defective mouths seen in the school group every year. The nursery school is as yet not a common thing, but these schools are rapidly springing up everywhere. Through them is presented to the dentist and pediatrician an opportunity for study and service in a group from which we have hitherto been shut out.

Some of the more intelligent parents begin to take their children to the dentist during the preschool age. In many instances, the results are not conspicuously satisfactory. My association with dentists has given me the opportunity of knowing something of what is considered the best procedure in the care of young children's teeth. I try to pass this information on to my patients. Among these there are a number of dentists' children. For example, regular cleaning of deciduous teeth and early filling of cavities are advised. Too often, I am met with the reply that daddy says that they are going to come out anyhow and that it's no use to trouble about them.

These teeth are allowed to decay until it is necessary to extract them, or they may be extracted for no reason at all except that it is the easier way. In this age group, more than any other, there is a need for working out a rational plan of dental care that, in its general principles, will be accepted and followed by all dentists and pediatricians alike.

Continuing our discussion along lines of historical necessity, we finally arrive illogically at the prenatal period, the point back to which we must come in our health-building progress. It is not enough to keep the well baby well, but ideal infant health demands that the baby be well-born or, to express it more aptly, born well. Our attitude toward pregnancy and confinement has been too much one of mechanics; our sole purpose seems to have been to bring about a perfect mechanical process that will not result in harm to the mother and infant. We have given but little thought as to what kind of a baby would result at the end of nine months of pregnancy. Not until the baby is born is he a subject of the care of the pediatrician. By this time, the health pattern of his body tissues may already be unchangeably laid down. We know the effect of nutrition of the expectant mother on the child's teeth and her own as well, for that matter; yet, how casual are the usual dietary instructions that the woman receives during pregnancy! How little thought is given to the essential matter of a well balanced diet containing sufficient food elements—minerals and the various vitamins!

Seeing as we do the results of lack of care on both the mother and the baby, we cannot but be impressed that here is one of our most pressing, immediate needs. The pediatrician is completely shut off from this phase of the child's development, as is the dentist, up to the point where repair work for the mother becomes a necessity. At this time, the dentist has some opportunity to advise her as to the importance of a correct nutritional regimen for her own sake as well as the sake of the infant.

In public health, we have limited access to these women through the prenatal conferences. Dental service in these stations should be made an essential feature of prenatal care.

Following as we have the history of the development of child welfare, we have seen that the introduction of each new activity has been to meet some outstanding need. As a result, these needs, in the several childhood age groups, are being met at the present time with varying degrees of adequacy. Unfortunately, we are doing less in the important prenatal period, as far as the future health welfare of the individual is concerned, than in any other. Through our prenatal conferences and contacts with private patients, we must point out the necessity of this kind of care. For a long time to come, the period of infancy must be bridged over by the pediatrician in respect to the care of the teeth.

Ideally, we desire to have these children come to you later with as nearly perfect oral equipment as possible. We are beginning to gain access to the preschool group and, with further education, this contact is going to increase. Our most complete accomplishment is in the school group. Here, we have elaborate and comprehensive health programs, so much so, in fact, that we must be on guard that the individual child be not submerged in a multiplicity of specialties. As we view all three efforts as a complete fabric, we must come to the conclusion that our program must be essentially one of prevention, beginning in the prenatal and continuing through the infant, preschool and school periods. The end result must be expressed in terms of health and happiness of the individual and the community.

THE DENTAL HYGIENIST: ARE THERE INDICATIONS FOR VARIATIONS OR CHANGES IN HER TRAINING?*

By LEWIS E. FORD, D.D.S., Los Angeles, Calif.

PROBABLY at no time in the world's history has there been a greater effort to improve the general welfare and efficiency of mankind. All forms of human effort are calling for and insisting on having better educated and trained people. Those of us who have selected the health problems of the human race as our life's work have assumed one of the greatest responsibilities, if not the greatest responsibility, of all the specialized groups, and if we are to meet our responsibilities, we must have all those who are cooperating with us proficient in their duties. Among this great number of co-workers in the fields of human welfare is the dental hygienist.

When we recall that it was only about fifteen years ago that Alfred C. Fones, of Bridgeport, Conn., conceived the idea of training a group of young women to render prophylactic dental service to the

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 23, 1930.

school children of that city, we must realize the rapid strides that have been made in this field of health service.

Dr. Fones, as you know, selected a group of prominent dentists to assist him in giving these students courses of instruction in scientific and educational subjects, in addition to the technical course. We all know how successful this course was and the great amount of good that it did, not only to the children of Bridgeport, but also to the world at large. The wide publicity given to this undertaking created a most favorable impression on the general public and health authorities, and with the definite statistical data that Dr. Fones was able to present to the dental profession and health authorities, it immediately demonstrated its worth; and so the vocation of the dental hygienist is no longer an experiment, but has taken its place as a needed phase of dental practice and public oral health service.

Most of you are probably better informed regarding the growth and development of dental hygiene than I am, but it is timely, I think, to remind you how few years ago this specialty started and the growth and development that it has made, not only in this country but also in foreign lands. At the present time, large institutions are being erected in two European countries, and a third country is considering the erection of a large unit, with the prospects of succeeding; and if it does, it will be supported by a million dollar endowment from the general government of that country.

In the United States, we have fourteen or fifteen schools giving courses in dental hygiene, but until the recent meeting of the American Association of Dental Schools in Toronto, no general meeting of this group had ever been held. In March, 1930, at the first general gathering of those institutions interested in the education and training of the dental hygienist, about thirty-five were represented, and for more than two hours, such subjects as just what the general duties of the dental hygienist are to be; how long her course of instruction should be, and the subject content of this special curriculum were discussed.

All present showed a keen interest in seeking additional information, and it developed that a considerable difference of opinion existed in the different sections of the country. Some felt that one academic year was sufficient and that all the hygienist was expected to do was clinical prophylactic work; others were of the opinion that a one year course should be required, with one additional year optional, with an added degree; and still others were of the opinion that a minimum two year course was necessary to properly prepare the students for educational, public health and institutional service as well as office practice.

As the concept of the objective of the dental hygienist appears to differ in various sections of the country, it would be impossible as well as impractical to attempt to suggest any changes in the curriculum as to length or contents without first determining the concept at which such modifications would be directed.

We find, for instance, that, in certain states, the concept of the duties of the hygienist is technical. She is to spend her time in the performance of such technical duties as are permitted by law and aimed at the prevention of caries through the cleaning and polishing of enamel surfaces at stated intervals throughout the year. But, even then, we feel that the acquirement of the technic of cleaning and polishing the enamel surfaces of deciduous and young permanent teeth would be an insufficient

training, and that she should be given sufficient instruction to enable her to cooperate intelligently with the dentist in the matter of advising parents as to the necessity of having certain dental operations performed, and also in advising parents and guiding children in the systematic care of the mouth and teeth. If she remained strictly a cleaner of teeth, she would be missing wonderful opportunities to teach to her young patients one of the fundamentals of preventive dentistry — intelligent home treatment. We feel quite sure that the rôle of the dental hygienist, if interpreted from so narrow and restricted a point of view, would eventually result in the discontinuance, in dental schools, of the courses that are now provided for her training.

In other states or sections of the country, the concept appears to be a dual one: technical and educational. In her rôle as a technician, her duties would be as previously stated, and in her rôle as teacher of oral hygiene, she would be called on to disclose her subject in the class room and before such organizations as are active in considering the problems of child health and welfare.

It has also been suggested that, in addition to her technical and educational duties, some of her time might be employed in the dental office in the capacity of dental assistant and secretary, the latter not as a permanent occupation, but simply as a matter of financial expediency until such time as her specific duties may require all of her available time.

In these states or sections in which it is believed that the hygienist should be not only a technician, but also a teacher of the rudiments of preventive dentistry, it should be remembered that a relatively small percentage only are equipped temperamentally or possess the poise and speaking ability to present the subject in a manner to awaken a deep-seated interest in children and adults in the subject of dental hygiene and its ramifications. It is not to be expected, desirable as it may appear, that every graduate dental hygienist will feel competent to carry on educational work in lecture form, and therefore the largest percentage will, after all, remain in the technical group.

But even if only a small percentage should enter the educational field, the curriculum of dental hygienist must be made to include a number of subjects which would not be required if the technical work only is to be adhered to. Others than those who are engaged as teachers of the subject may be called on to give lectures or talks before groups of teachers, women's organizations, nurses organizations, etc., and they must be prepared to deliver their lectures or addresses with scientific accuracy as well as in a manner pedagogically acceptable. We cannot see, therefore, any reason for curtailing the subject content of the curriculum as formulated in our institution or the prescribed period of two years. We cannot conceive how the training that these hygienists should have technically and pedagogically could be accorded only one year with any hope of preparing these young women to carry out their duties satisfactorily to others as well as with credit to themselves.

But from the technical standpoint, the dental hygienist's work must necessarily be quite restricted, if the laws regulating the practice of dental hygiene in so many states are to be observed to the letter. Their work must not, so the law dictates, reach beyond the gingival margin, and consequently if such laws are not suitably amended, the best work of the hygienist will be carried out in the educational

field. Do not let us overlook this important and vital point that the dental hygienist properly trained and intelligently guided can become an important factor in the problem of caries prevention. That a clean tooth does not decay may be in some aspects an exaggerated dictum, but nevertheless it is a fact that clean mouths of children, those which are subjected to careful and painstaking prophylactic care at relatively frequent periods, are those mouths in which the incidence of caries is much less than in neglected mouths. And as dentists as a class have shown a disinclination to attend to the dental needs of children, it seems that it is high time for the dental profession to appreciate the important part that the dental hygientist should be called on to fill in the realm of oral hygiene. The interest that the profession has exhibited as regards the problem of the dental hygienist is quite insignificant. It would appear that the point of view of her possibilities as a factor in decreasing the rate of incidence of caries has not as yet penetrated the conscience of the profession, she being looked on by a respectable majority merely as a cleaner of teeth and, in some instances, as an office asset economically. As an outcome of this situation, at least as far as California is concerned, the demand for dental hygienists originates with school and civic authorities rather than with the profession. As far as the dental profession is concerned, the situation is by no means hopeless. It takes time to instil into a profession acceptance of an innovation which at first may appear to be an intrusion into the prerogative of its members, but time may show that instead of professional intrusion, it is really a situation with wonderful possibilities in the field of preventive dentistry. The fact that the American Association of Dental Schools saw fit, at its last session, to devote time to discussion of the training of dental hygienists and their future place in the scheme of health conservation is indeed a hopeful sign.

It is probably best, we think, for the present at least, to continue independently in this educational experiment and to postpone any effort at educational uniformity until such time in the future as more data and information have been collected, as a basis for determination of the educational needs of the dental hygienist. Any attempt at this time to standardize the curriculum of the dental hygienist would probably prove unsatisfactory and confusing.

Personally, I incline toward the opinion that her functions should be dual: educational and technical, with special emphasis on the former. The possibility of the hygienist's doing considerable good, technically, by looking after the tooth surfaces of children's teeth impresses itself on us as an outstanding measure in the prevention of caries of the deciduous and permanent teeth of children.

It is my hope that the officers of the American Association of Dental Schools will recognize the importance of this calling and create a special section on oral hygiene where, at their annual meetings, those who are teaching in this special department may meet and carefully consider and discuss the needs of and the instruction necessary properly to prepare these women for their life's work.

I am also inclined to think that the Dental Educational Council of America will take cognizance of this field of oral service and will probably insist upon a more uniform course of instruction. In my opinion, we should be optimistic, for there are many indications that the development of the dental hygienist has barely started.

FUTURE OF THE DENTAL HYGIENIST

By CORA L. UELAND, Los Angeles, Calif.

THE future dental hygienist is destined to show a marked advancement over the present hygienist. When we analyze the dental hygienist as she is today, we find her occupying any one of the following positions: as oral hygienist in the public schools, in private dental offices, in county or state positions, in hospitals, in mercantile and industrial organizations, in commercial concerns and as supervisor in schools for dental hygienists. In any of these positions, except the last, with which we are not so much concerned here, the dental hygienist is doing educational oral hygiene work, dental assisting or prophylactic work. In some instances, she may be doing all of these, this depending on the type of position that she holds.

The dental hygienist has been an important factor in the progress of preventive dentistry. Her services in any of the above mentioned types of positions have been a stimulus toward a development of tooth consciousness and have increased the appreciation of dental service in the minds of many people.

A great many of the dentists throughout the country appreciate the services of the dental hygienist, but the dental profession, as a whole, does not yet fully realize the value of these services and the place which this profession fills in the actual practice of dentistry. The main reasons for this is the lack of interest on the part of the majority of the dentists in the type of work which the dental hygienist is taught to practice—that of oral hygiene—and lack of information in regard to the dental hygienist profession. There is not a greater practice builder for the dentist than a capable dental hygienist, and those who have employed competent dental hygienists are loathe to do without their services. Whenever the members of the dental profession fully appreciate the meaning of oral hygiene and endorse its practice, they will have grasped the ideal for which the dental hygienist stands, and then, too, will the dentist and the dental hygienist be greatly benefited and the public better educated in oral health problems.

The dental hygienist profession is a new one, but it is no longer an experiment or a theory. It is quite generally accepted, and the services of the dental hygienist are deemed important by those acquainted with the results of her work.

It is true that the majority of dental hygienists practicing in the United States today are largely doing operative work. This is because of the motive with which dental hygiene started, cleaning the teeth by operative means, and also because of the type of training which she has been and, in many instances, still is receiving. The majority of schools have leaned

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 23, 1930.

toward a technical training, and students practice as they are taught.

There are fifteen dental hygiene schools in the United States, including the one in Hawaii. Of this number, five maintain a two year academic curriculum; one, an eleven or twelve months' course; one, a ten months' course; one, a nine months' course with a second academic year as optional; one, a nine months' course with a second academic year of internship in the public schools of its state, and the remaining number, a nine months' course of study. A dental hygiene student, like any student, follows the line of least resistance. She will attend school where she can get her education in the shortest time, and we find the majority taking their dental hygiene training in the shorter term schools.

The question as to what the educational curriculum for the dental hygienist should consist of and the length of her course of training is an important one, especially at the present time, since there is much discussion and desire on the part of many of the authorities in the dental hygiene schools to bring about a fairly uniform curriculum for the good of the profession. A meeting held within the past year for this purpose served as a stimulus, but carried no great accomplishment, which was to be expected. It showed that the school authorities had a great interest in the dental hygiene profession and that there were many varied opinions on the subject of dental hygiene curriculums.

The time is not far distant when the majority of the courses of study for dental hygienists will be fairly uniform in length and content, as they should be, for the following reasons: (1), that a dental hygienist from one state may go into another state and be qualified to take the state board examination; (2) that in case a dental hygiene student moves into another state, and is compelled, by so doing, to change schools, she could, with little extra work, continue her course in dental hygiene; (3), to maintain the same high standard of dental hygienists in each school, and (4) to standardize the dental hygiene laws of the various states.

The demand on the dental hygienist as to the performance of her duties in the past has been satisfactorily met by her. I respect the schools of dental hygiene which have trained these girls and in no way wish to criticize their efforts. They have done well considering that the average student was in school only thirty-two weeks.

The advancement of this new profession has been great since its beginning and up to the present time, but its progress in the future is destined to be greater. The demands on and expectations regarding the dental hygienist are increasing from year to year, and the future calls her into educational work. This is the ideal of her profession. By this educational phase of oral hygiene, I mean a broader, fuller, more logical service in the problems of the theory and practice of educational oral hygiene work than has been practiced in the past in any of the various types of positions which the dental hygienist might hold.

We realize that mouth hygiene can never hope to accomplish its goal by operative means alone. It must have the educational phase, and the principal teacher of the public in oral health will be the dental hygienist, but she must be prepared educationally for this kind of service.

Education, as we know, is a dynamic force which is constantly changing to meet the requirements of civilization. A method of training which might have been satisfactory at one time, in any profession, will not be sufficient nor satisfac-

tory to meet the growing demands of that profession in the future. Dental hygiene in no exception.

The majority of schools for dental hygienists have, as stated before, leaned toward a technical training in the past, which was all they could give efficiently in the short space of nine months, and this phase of the work has been given thoroughly in all of the schools. But the future, which demands that the dental hygienist be an educator and a teacher in oral hygiene as well as a technician, will require at least a two year academic course. Time will tell whether or not this will be sufficient time to educate these girls to meet the demands of the public.

The future dental hygienist must be educated rather than trained. She must be on the par, educationally, with the teachers of the elementary school grades throughout the country; that is, her length of training must be equal to that required by the majority of teachers in the grades. The main difficulty which is confronting the dental hygienist today and will confront her in the future in school, institutional, county and state positions is that of a feeling of inferiority by the teachers in the public schools toward the dental hygienist. A dental hygienist with nine months training is not equipped for the same standing as the regular teachers are, and when she draws a teacher's salary and stands as an educator in her special field, her preparation for this work must equal that of those whom she will be in contact with in doing her duties.

The subjects which are essential and must be added to the present dental hygiene curriculum to equip these students to meet the future demands are: English and composition, public speaking, biology, chemistry of foods, foods and nutrition, child and adult psychology, theory and practice of class room teaching and a special course in theory and practice of education oral hygiene work. There are others, but these are the most important ones.

This brings me to a question which is receiving a great deal of discussion today: Should there be two classifications of the hygienist and her education, depending on whether she plans to go into public health and school work or is going into a private office as an assistant and in charge of prophylactic work? The future will see the greatest majority of dental hygienists in public health and school work, and I believe that, for the sake of maintaining a high standard in the profession, and that all of these girls may be assured of some type of position, every student dental hygienist should receive the maximum education offered by any of the schools of dental hygiene and that these courses of training should fully prepare and equip these girls for every phase of work in the dental hygiene field. The dental hygienist, after graduating, may choose the type of work most appealing to or fitted for her, and whether or not she wishes to continue in the same kind of work or make a change to try some other type is for her to decide. At any rate, she cannot claim ignorance of any phase of dental hygiene, for she has received the maximum education.

Let us not criticize the dental hygienist because of poor or insufficient training, lack of supervision, or through a lack of interest in or an understanding of her, but let us be among those who are constructive in our criticism of the dental hygiene profession, with a thought of its future in mind.

The future of the dental hygienist is full of promise. It calls for a better

educated, broader minded, more adequately equipped girl, one who is able to hold her own with other educational and health workers, one who can think in terms of highest service and who will take the best out of new facts, as they are discovered, and use them in protecting the public from one of the greatest diseases of our time, dental caries.

BEHAVIORISM RELATED TO DENTISTRY*

By GEORGE B. MASSLICH, Riverside, Ill.

A PSYCHOLOGIST is said to be a person who tells you things you know in words you can't understand. For this reason, I am not coming to you as a psychologist. However, behaviorism is a kind of psychology; a curious branch of the subject possibly, but one which comes into the present discussion.

I remember once hearing Dr. Watson tell, in an interesting and convincing manner, how he had experimented with guinea-pigs and white rats to find out how they would act in unusual circumstances. This was long before he announced his theory of behaviorism, with which his name has been most prominently associated. The astounding thing that Dr. Watson said was, "Give me a dozen healthy infants well formed and my own specific world to bring them up in and I'll *guarantee* to take any one at random and train him to become any type of specialist I might select; into a doctor, lawyer, artist, merchant-chief, and, yes, into beggarman and thief regardless of his talents, penchants, tendencies, abilities, vocations and race of ancestors."

It was this claim, as much as anything else, that led to this group being dubbed "misbehaviorists" — those who recognize no such thing as mind, but by purely bodily and chemical means have established a science. This led some wag to declare that psychology first lost its soul; then lost its mind; then lost consciousness, and now retains only behavior.

A rather more readable book for most of us is Professor Dorsey's "Why We Behave Like Human Beings," in which he tells a good deal about types of behavior and their causes.

Quite recently, Frederick H. Lund has written a books on "Emotions of Men," in which he holds that "the things man does and the things he seeks have little or nothing to do with reason," and that he is "moved by impulses which are not rational but emotional." In speaking of politics, the author says that the average individual finds real thinking too troublesome and so "thinks with his feelings," and that the politicians, knowing that men are controlled more by endocrine secretions than by intellect and must be convinced by appeal to their emotions, aims always to get results in this way.

But we are here concerned not with behaviorism as a science but with be-

*Read before the Section on Mouth Hygiene at the Midwinter Clinic of the Chicago Dental Society, Feb. 4, 1931.

haviorism as related to dentistry, or, in simpler words, dentistry and conduct.

Now the matter isn't so simple as the obvious fact that if a boy has a raging toothache he isn't likely to show a very agreeable disposition or to keep his mind on his school work. Some one has said, in answer to the question "Is life worth living?" "It depends on the liver." He might as well have said that it depends on the teeth, if he could have made a pun out of his reply.

Some time ago, the *American Magazine* printed a long and intimate interview with Willis A. Sutton, superintendent of the Atlanta schools, and now president of the National Education Association. Mr. Sutton relates that, although he has felt that expelling any boy from school is the worst possible thing, he was, several years ago, faced with a situation that seemed to demand it. One boy, Robert, had made life so miserable for his teachers that they threatened to resign if he was not expelled. Robert was sent for and told what was to happen.

"Can't you beat me instead?" he pleaded.

"I don't beat boys," Mr. Sutton told him.

"If you turn me out, where'll I go?" he demanded. "I haven't a friend on this earth."

Mr. Sutton then noticed that the boy's teeth were very bad and it occurred to him that this condition might have something to do with his outrageous behavior.

"I'm going to make a bargain with you, Robert," he said. "If you will go to a dentist and have your teeth fixed and bring me a note from him saying that you are doing this, you can continue to come to school for six weeks longer. At the end of that time, if your conduct has shown marked improvement—well, you can stay."

"At the end of three months," Mr. Sutton goes on to say, "I finally screwed up courage and broached the subject at a faculty meeting. "What's become of Robert?" I asked. "Never saw such a change in a boy in our lives" they declared. "What did you do to him?"

"Nothing. Had his teeth fixed." "Then, for mercy's sake, let's have a dentist on the faculty."

This was the beginning of Mr. Sutton's interest in good teeth for the children of Atlanta, which resulted in a campaign for oral hygiene that rounded up the entire 60,000 school children.

I'm sure that I was not asked to appear on this program to tell you of one bad boy in Atlanta who had his teeth fixed, but probably I was asked to speak because I have had so much experience with bad conduct here in Chicago and possibly that fact might not justify my appearance. I recall that a woman once said to a visiting nurse, "You can't tell me anything about how to bring up children. Haven't I buried six of them?" Perhaps it would have been better to have chosen as speaker some one who was acquainted with good conduct.

My position as superintendent of the Chicago and Cook County School for Boys gives me a personal acquaintance with many of the worst boys in Cook County. The baby bandits who get their names in the daily papers are probably wards of my school or soon to become its wards. One of the pair of young men who were the first to go to the electric chair in Illinois and one of the last young men to be hanged in the Criminal Court yard had been at my institution several years ago. Within the last few months, there appeared on the front page of the morning papers the story of a youthful

gangster taken for a ride and found in a ditch west of the city, his body riddled with bullets. I had talked to him at my desk a little time before that, urging him to get a job, be independent and stop having the police forever on his trail; but evidently he could not break with the gang. The behavior of these delinquent boys committed to us by the juvenile court makes a most interesting study, and before I speak more at length on the contact these boys have had with dentistry, I want to relate the experiences of several of them.

One boy, who, by the way, was never committed to the Chicago and Cook County School, lived on the northwest side of Chicago and had been working steadily for several months. One Saturday night, with his week's pay in his pocket, he started for a movie show. Stopping in front of one theater and not caring for the picture, he started to walk to another theater a mile or two away, when he saw a couple park their car and go into the show. He got into the parked car, succeeded in starting it and drove to the other theater, being careful to get back before the owner came out. The police saw and recognized the auto and arrested the boy. As he was being brought into the police station, a woman fainted and, during the confusion, he walked out the door. Boarding a street car, he went to a railway station, bought a ticket for St. Louis and left town. In St. Louis he got a job, worked several weeks and saved as much money as possible. When he had earned the train fare, he went to New Orleans and, without asking any questions, slipped on to an ocean liner, which happened to be bound for Germany. He worked his passage over and, not caring to stay, worked his passage back. From New Orleans, he earned his fare back to Chicago, and, one day, astonished the police by walking into the station from which he had escaped several months before. The joke was on the police and they, of course, did not press the charge. The man whose car the boy had taken helped him to find a job.

Walter was a 10-year old Lithuanian boy who ran away from the Chicago and Cook County School, as he had run away from home and from a church school to which he had been sent. One time, he got as far as Oak Forest, and while the police were telephoning his parents, he took a revolver from the desk and disappeared. Another time, he was picked up at Renssalaer, Ind., and stayed a week with the sheriff, whose wife took a fancy to the boy. She wrote me of her interest in the "dear little fellow," but asked me to find out what Walter had done with her husband's revolver and handcuffs. Later, the police of Lafayette, Ind., started him back to us, but, when he reached Chicago, he turned around and left for Terre Haute and Brazil, Ind., breaking into a hardware store in that town and taking a revolver and a thousand cartridges.

I once asked Walter why he usually went to Indiana and how he could get as far as Brazil, 230 miles away, dressed in overalls and shirt and with no money in his pocket. He told me he would go to the Englewood station and when a Pullman train came in, he would crawl in between the sets of wheels on the wooden beams known as sleepers. "Then," he said, "if it was night, I would go to sleep, and when I woke up, it would be day." Just this fall, Walter was committed to a reformatory in Indiana.

What will this wanderlust do to the boy? Will he be a rolling stone, never happy for a long time in one place? Will he change from one job to another without making any progress? Will he, per-

haps, sometime marry and then desert his wife? Who knows?

Another boy, Steve, is the youngest of five brothers. When he was with us, one brother was in the state school for delinquent boys at St. Charles, one was in the Bridewell, one was in the Reformatory at Pontiac and one in the Indiana State Prison—five brothers locked up and supported by the state, all for having taken automobiles. In talking with Steve's mother, I asked her why all her boys had gone wrong, and she replied, "We don't want them to be bad. We go to church and we pray at the table." Then I learned that Steve's father had lost more than one position through stealing tools—stealing to buy liquor.

William was a boy sent to us for breaking into freight cars. He was only two-thirds as intelligent as most boys; he had a 50 per cent vision, he was flat-chested, stoopshouldered, and nervous, and he had enlarged tonsils. Furthermore, his father was dead, his brother was feebleminded, and his mother, probably because of low mentality, had allowed her house to be dirty and her children to be poorly clothed and ill-fed.

David, while living at the institution, was allowed to work in Chicago. When a week had elapsed and it was pay day, he turned in $10 as his week's wages. Another boy out looking for work told us David could not have been working as he had seen him loafing around on several occasions. A second boy reported that David had won $10 throwing dice in a little foreign grocery near his home. I telephoned his mother, and she said that she had given David the money to turn in so that we would think he was working and would allow him to go out the following week. Are you surprised that David continued to steal automobiles?

There is Roy, whose attitude toward his father, a helpless cripple, I could not understand until I learned that the father had contrived a long whip of wire with which he could strike the boy from his bed.

There is Clifton, whose mother put him in an orphanage when his father died, and left him there for nine years, while she married again and moved to another state. He is a dull boy, but has a fine tenor voice. He will probably continue to steal trucks and make nothing of his musical talent.

There is Eddie, whose mother is a widow helped by charity. Eddie's uncle was a Chicago gangster, shot to death in the street, and Eddie himself has been the leader of a gang of boys.

There is Sam, whose father, although an invalid, was on the payroll of the sanitary district. The little sisters helped support the family by making paper flowers, but Sam and his brother continued to take automobiles.

Half the stories I could tell would be stories of success, for the figures seem to show that about half our boys do not get into further trouble; but some of the stories are tragic enough.

Several years ago, a quiet, obedient boy, Walter L., was sent to us. It seemed that, one evening, a girl in the neighborhood had asked Walter to go with her to the church for her baptismal certificate. Walking along, they passed a parked car, and Walter said "Let's borrow the Marmon." They got in and, for company, took two or three other girls of their acquaintance. It wasn't a joyride to them—just a business errand. Walter was driving rather fast, although there was a little snow on the ground and it was slippery. One of the girls said, "You bumped something, didn't you?" "No," he replied, "I guess not.

Maybe I grazed the Ford parked at the curb."

They got the baptismal certificate, and Walter drove home, leaving the "borrowed" Marmon where he had found it. But the car *had* bumped something. It had struck a young woman and left her lying dead in the street.

How much shall we blame Walter when I tell you that he was feebleminded? Although he looked like other 16-year-old boys and was able to drive a car, he had the judgment of an 8-year-old child, and so was not in large measure responsible.

Thomas A. Edison recently said "Civilization is just a lot of people in one place plus a policeman." But it takes more than brass buttons and a star, more than a club and a revolver to keep persons from doing the things that they want to do. Why should a boy want to sleep under his own porch and freeze his feet rather than go inside? I know of a 12-year-old south side boy who did that and froze his feet so badly that he had to be taken to the county hospital. Why should boys who have cars of their own steal cars? I have known of several who did. Why should a boy trade a pair of new shoes for a cigaret? One of our boys did that a short while ago. Why will a boy spend his week's wages in one day in restaurants, movies and candy stores, and, then, afraid to go home, wander about for days with almost nothing to eat, and nowhere to sleep until the police pick him up?

One day, I put a boy in charge of four others to do some work on the highway at the edge of our grounds. He got the work finished and sent the others back with the tools, but he hopped on a passing truck and ran away.

Another time, I sent a boy to the loop dressed in his own clothes and with $3 to buy several things for the school. He returned with the purchases, changed his clothes and when he was in overalls and blue shirt (the costume our boys sometimes wear), he ran away.

One winter night, when the temperature was near zero, three of the smaller boys got out of the dormitory, each in his nightshirt and wrapped in a single blanket, walked nearly a mile in the snow barefooted, climbed into a truck and sat huddled together for hours until some one found them and brought them back.

Some of you may expect me to say next that if we had had a dentist on our faculty, all these boys that I have described would now have reformed and have become useful members of society. As a matter of fact, several of them did have dental treatment as part of our program to help the boy overcome his delinquency trends. Three times a week, we send six boys to the Cook County Children's Dental Clinic, and have been doing so for years. Furthermore, we grant to any parent who wishes to have his son treated by the family dentist the right to take the boy from the grounds for that purpose. While I cannot cite any startling change in behavior of any of our boys that compares with the story of the boy, Robert, of Atlanta, we all feel that bad teeth have been a serious handicap to a large proportion of our boys, and we are pleased both at the cheerful way in which they submit to dental treatments and the improvement in attitude which so often follows.

A number of years ago, when a beginning was made in sending dentists into the public schools to teach and demonstrate oral hygiene, I was the principal of an elementary school on the northwest side which was attended principally by children of a foreign-speaking group

known to have poor teeth. For that reason, I made early application to have my school placed on the first list, and I can bear witness to the high quality of the service and to the children's keen interest in caring for their teeth. My faith in the value of dental hygiene, therefore, does not date from the writing of this paper nor from my coming to the Chicago and Cook County School, although my interest has been in making the child happier and more efficient and not directly in influencing his conduct.

Just as there are a number of conditions that cause juvenile delinquency, there are a number that may cure it. The story is told of a Sunday school visitor who said to the children, "If God had made all good little boys and girls white and all bad little boys and girls black, what color would you be?" Several boys thought they would be white, but one conscientious little girl raised her hand and said,, "Please, sir, I think we'd be streaky."

I want to discuss one other relation between behaviorism and dentistry, but before doing so, I should like to answer a question which I feel sure is in the minds of several: "What can you do to reform these boys?" One obvious service that we can render them is in physical upbuilding, particularly the care of teeth, tonsils, ears and eyes. It goes without saying that we appreciate the excellent work of Dr. Ubl and his associates at the Cook County Children's Dental Clinic. It does seem unfortunate, however, that one of the best ways for a boy to get help in making himself physically fit is for him to become delinquent.

Nearly all of our boys are retarded in school. Much of this retardation is not due to inability to keep up with the class, but to truancy, followed by discouragement and maladjustment. Many of our boys are surprised to find that in a class with other boys of the same kind, they can keep up and even skip a grade. This means that when they are paroled, they do not go back to the teachers whom they disliked and who may not have been altogether pleased with them.

It is of great value to a retarded boy to discover that he really can learn and to realize that when all the other boys are going to school, it isn't a hardship for him to be with them.

Another service that we render the boys who are committed to us is in helping them get proofs of their age and in securing employment certificates or age cards. This is often not an easy matter for those who have had no business experience.

In the few weeks that a boy is with us, we do not attempt to replace the habits of several years of night life with its cigarets, crap shooting and general lawlessness by substituting the tame existence of regular hours, regular meals and continuous supervision. Reformation probably comes about only when some new situation has entered into the boy's life or some half-forgotten aspiration comes to light with a chance to be fulfilled.

The boy whose physical defects are corrected, who has advanced into a new grade or who has qualified to go to work may be in a fair way to overcome his delinquent ways.

All of us are singularly immune to the benefits of some other person's experience. As we drive our car on a slippery roadway, we see the other man skid, but are not much more careful in consequence. Just so, the delinquent boy whose pal has been shot by the police while trying to get away in a stolen car is not deterred from a like attempt. He feels that this could not happen to him. Threats, warn-

ings and entreaties have fallen on deaf ears not only in the case of these boys but in that of everybody else as well. The most effective method of impressing and inspiring boys to do better is to present to them some man who can serve as a hero. With this in mind, it is our practice to bring to the weekly school assemblies as speaker some man (or it may be a woman) who has made a success in some vocation. I suggest to these speakers that they do not preach to the boys, do not mention the prodigal son and do not refer to delinquency, but rather that they talk enthusiastically of the joy of living, the satisfaction of achievement, the thrill of being present in this world of progress. After all, the delinquent boy, and likewise the normal boy, and even you and I, are trying to get satisfaction out of life. The difference is only that the delinquent is getting his thrill by doing things which society does not relish. All of us want recognition, we want to be liked, we want our actions to be approved —in our own set. Some of us like to see our names in the newspaper. Possibly, some of us like to see our names in gold letters on an office door. What the delinquent boy wants and gets is recognition among the other boys of his group, which happens when he can show a clipping from the newspaper referring to him as a baby bandit or a youthful gangster.

Expressed in another way, the problem of overcoming juvenile delinquency is just the problem of setting up a better and higher type of satisfaction, to be gained by more lawful pursuits. It is the opportunity which you dentists have of rendering a service to your community that has prompted me to speak, as I did a few minutes ago, of this other relation between behaviorism and dentistry. I'm not suggesting that you leave your offices to do this or that you attempt a combination of the profession of dentistry and the profession of boys' work. Instead, I have discussed at some length the motives, as I see them, that determine a boy's conduct, and I suggest that, if you will, you can be heroes to the boys who may sit in your operating chair. None of these boys may be delinquent or ever become delinquent, but they are boys who are looking to the men around them for the cues on how to succeed in life. You may not realize it, but a boy is apt to admire cleanness and neatness in a man. The boy may pay no attention whatever to the grease spots on his own clothes, the dirt under his finger nails or the smudges on his face (to say nothing of green and brown tinted teeth and bad breath), but he is pretty sure, though not always consciously, to have a poor opinion of the man who is careless of his personal appearance.

Then, nearly every boy admires a man who is deft and skilful. No matter if sitting in the dentist's chair is, as my son once said, when he was very young, "the hard part of your life," the boy watches with keen interest as the dentist selects a particular instrument of torture from a rack of carefully graduated steel points and as he handles his entire pain-producing equipment with precision and style. I don't think that I'm exaggerating when I say that the dentist rises or falls in the boy's estimation with every move he makes in the technical process. We are in error if we think that a boy who throws his cap into the corner and can never find his skates does not sense any such lack of system and order in his dentist. Nor are we to expect a boy to show his true feelings. Some time ago a large boy was committed to us who showed every sign of being "hard-boiled." He swaggered around, snapped back re-

plies to his house officer and acted the bully. Calling him to my desk, I began asking such questions as his grade in school and his father's first name, and presently I saw that there were tears in his eyes. I asked what was troubling him, and he replied, "I'm so darn homesick, I don't know what to do." He said that with all his misdemeanors he had never slept away from home. I promised him that if he still felt homesick the next day I would take him home for an hour or so, but he overcame his homesickness and dropped his belligerent attitude.

To be sure, personal neatness, office tidiness and skilful manipulation are not exactly the essential elements of a hero, and yet they may be sufficient to establish a man in the estimation of a boy, so that whatever the man says or does is accepted as the proper thing.

In short, it is possible for a man to win a boy's esteem by comparatively simple and unimportant acts and then be in a position of great influence when he displays his attitude and philosophy of life. The unfortunate part of it is that so many men not only fail to realize the unusual opportunity to be an inspiration to some lad but go to the other extreme and adopt a pose of sophistication and braggadocio. Too many men, in the professions and in business, interlard their ordinary talk with profanity and coarse words or tell stories that are off-color. Too many men talk flippantly of graft, of racketeering, of marital infidelity and of dishonesty in business. Too many men, whose own conduct is law abiding, speak with gusto of passing the buck, of easy money, of getting by, of putting it over. It is a trait of bragging and boasting that should be left to boys.

I have in mind a dentist who is a member of your society and who, if I am any judge, is conscientious and skilful. More than that, he is a man who cannot be drawn into a conversation in which he drops to a lower level of mean gossip, slighting remarks and improper talk. Such a man should be proud to know that boys who are in his chair will pattern after his ways and be benefited. Some time ago, in a locker room, I overheard a young dentist talking in a loud voice to another young dentist and telling him what a huge fee he expected to charge a patient who could stand the cost; and how much his profit would be. Remarks were made that were not exactly complimentary to the patient, and there was some fun at his expense. That dentist will have boys in his chair—boys who may need every incentive they can get toward higher living. If they don't get it—and they may not from him—both dentist and boy will be the losers.

Let the man who meets boys on terms of professional intimacy congratulate himself on the service that he can render not only by his scientific skill but also through his soundness of character.

If, as I have suggested, our conduct is determined largely by the way we feel, the dentist may, in the first place, contribute toward reducing juvenile delinquency through the regular channels of his profession. He may multiply these good effects by furthering dental clinics of the right sort, where corrective work is so mixed with education that its benefits are lasting. When I visited the clinic presented to the city of Rochester by George Eastman, I wondered at its magnitude and system and influence. If my psychology is right, the dentist may, in the second place, actually reduce juvenile delinquency by adding to his dental technic the technic of the gentleman, the upholder of ideals, the inspiration of right living.

In these two ways is behaviorism related to dentistry.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Tonsillectomy in Acute Cervical Adenitis: The present report, by Harry L. Baum, (*J. A. M. A.*, Dec. 13, 1930), is based on a study of forty cases in which tonsillectomy was performed in the treatment of acute cervical adenitis in children as a means of controlling the glandular condition when the infection was at its height. The author unqualifiedly recommends operation when conservative treatment, i. e., rest in bed, local applications of ice and various medicaments, internal medication of various sorts, vaccines, light and roentgen therapy, has been given a trial and has been found wanting. The author states that he is never deterred by the age of the patient, the presence of fever, the high white blood count and loss of hemoglobin or the toxic condition. Neither does the fact of recent recovery from an acute tonsillopharyngitis serve as a deterring factor, as long as the throat is not then the seat of a frankly acute inflammation, which it never is by the time the glands are well established in their inflammatory reaction. There was not a suggestion of mishap in the forty cases in which tonsillectomy was performed at the height of the glandular infection. In fact, in every case, the improvement was "remarkable, in many almost miraculous." From twenty-four hours to three days from the time of operation was the usual time required for subsidence of both glandular swelling and temperature, the average time for the series of cases reported being three and two-tenths days.

Agranulocytosis: A case of agranulocytosis, with clinical recovery, is reported by George Parker (*Illinois M. J.*, December, 1930), in a married woman, aged 53, with no history of previous illness except an operation for nasal polypi and ethmoiditis. The present illness was attended by fever, increased pulse rate, marked prostration and mild delirium. Oral examination revealed a follicular tonsillitis with slight necrosis around the crypts, stomatitis and *fetor ex ore.* Slight cervical adenopathy with tenderness and dysphagia were noted. A mild jaundice was accompanied by nausea, vomiting, abdominal pain and diarrhea. The spleen was enlarged. There was absence of hemorrhagic diathesis. A marked leukopenia of 1,000 with 11 per cent granulocytes, a relative lymphocytosis and a negative blood culture were additional findings. A slight secondary anemia, with continued increase of platelets, was of short duration. The illness developed July 20, with sore throat and fever. July 29, the patient was very ill, with temperature of 103, severe angina with dysphagia, backache and marked prostration. She was admitted to hospital August 1, and remained there until September 13, after which time she was kept under observation, her general condition showing gradual improvement. She complained of easy fatigability and intermittent sore throat. Leukopenia and granulocytopenia continued up to ten months after discharge from the hospital. The treatment of the case, the author characterizes as "rather fanciful": bone marrow, yeast and a diet stimulative to the bone marrow, such as red meats, liver, fruits and vegetables, leukocytic extract and sodium cacodylate and roentgen-ray treatments (two) over the long bones. The author suggests that the question of chronic ethmoiditis as an etiologic factor in the persistent blood picture is to be considered.

Acute Maxillary Sinusitis with Meningismus: A case of paranasal sinus infection marked by symptoms of meningeal irritation which immediately disappeared after treatment of the maxillary sinuses is reported by S. M. Morwitz (*Illinois M. J.*, November, 1930), in a child, aged 11 years, who was admitted to hospital with a history of frontal headache with nausea and vomiting of four days' duration. There was a suggestion of rigidity of the neck; Kernig and Budzinski signs were missing; no tenderness was felt

over frontal and maxillary sinuses or mastoid. A thick mucopurulent discharge came from both sides of the nose and the nasopharynx. The temperature ranged to 102. Meningitis, sinusitis and influenza were considered. A large amount of pus was suctioned from both nostrils. Under local anesthesia, both maxillary sinuses were irrigated. From the right antrum, return fluid contained a large amount of thick floccules of pus. Silver nitrate was instilled. There was no headache after irrigation of the sinuses, and during the week following the condition steadily improved, reflexes became normal, neck rigidity disappeared, the right ear discharged without pain and the appetite improved. Suction was applied daily by cannula directly to the mass of secretions in the nasal chamber. Ephedrin 3 per cent, followed five minutes later with 10 per cent neosilvol, was instilled into the nose every four hours. Culture of pus showed staphylococci. The spinal fluid was negative. The patient was discharged feeling fine, with nose clear and ear dry.

Vincent's Infection: Treatment of 500 cases of Vincent's infection is reported by C. O. Giese and A. Lee Briskman (*Colorado Med.,* October, 1930). Poor results in the treatment of several cases at a union printers' home led to the making of mouth smears of everyone connected with the home. The percentage of those found infected was 93.5. Preliminary to treatment, all toothbrushes were discarded and each patient was given a bottle of 2 per cent sodium perborate solution, with instructions to use it every two or three hours. Later, selected cases were given a mouth wash consisting of equal parts of hydrogen peroxid and saturated solution of potassium chlorate diluted with equal parts of water. Each patient received daily treatment from the dentists in charge, consisting of spraying of the gingival margins with a solution consisting of glycerin, 40 parts; wine of ipecac, 24; solution of potassium arsenitis, U.S.P., 40, and hydrogen peroxid to make 480 parts. Also, the gum margins were painted with a 7 per cent solution of chromic acid. Smears were taken on the fifth and tenth days, and those patients showing definitely positive reactions on the tenth day were given injections of either neo-arsphenamin intravenously or bismuth intramuscularly. The authors conclude that Vincent's organisms are present in practically every mouth. Treatment must be persistent until smears become negative and remain negative even though symptoms may have disappeared. The organisms are not found in the edentulous. Early cases may show no signs and the symptoms may be very slight. The infection in association with syphilis is most difficult to cure. Destroying one of the organisms will not cure the disease. Suspected cases of pulmonary tuberculosis with a persistently negative sputum and atypical chest findings should be suggestive of Vincent's. A negative diagnosis can never be made by inspection alone. It is important to keep the mouth alkaline. Potassium chlorate mouth wash is a specific for the fusiform bacillus. In 83 per cent of cases that were still positive after injection of neo-arsphenamin, reaction became negative with one injection of bismuth, 3 grains at a dose.

Tooth Growth in Experimental Scurvy: In this experiment, the normal growth rate of the teeth of guinea-pigs was determined. Animals were placed on the Sherman-LaMar basal diet with 1 per cent cod liver oil. During the test, the animals were scored by the Sherman method for scurvy and weighed every fifth day. At the conclusion of the experiment, the animals were killed and the lower jaws, ribs and extremities were examined histologically. The incisor teeth were checked at various levels for determining the degree of scurvy. The vitamin A supplements were contained in diets of orange juice, tomato juice, turnip greens and mixed green vegetables. On 5 c.c. of orange juice daily, the rate of tooth growth increased and there were slight scorbutic lesions in the incisor roots but no scurvy evident by the Sherman score, which is based on the weight curve plus clinical observations as to pain, hemorrhage, etc. One cubic centimeter of orange juice increased tooth growth, but pronounced scurvy was found in the incised teeth. Tooth growth was scarcely increased on 0.5 c.c. orange juice, and advanced scurvy was present, in contrast with the Sherman score of moderate scurvy. Animals on the basal diet alone showed a tooth growth for the first fifteen to twenty days, which then ceased, but recommenced after the administration of 5 c.c. of orange juice daily. By studying the appearance of scorbutic substances in amputated teeth compared to those uncut and subjected to normal chewing strain, it was found that the stress is a definite factor in the scorbutic process. Photomicrographs

show the changes in the odontoblasts and the formation of osteodentin.—Gilbert Dalldorf and Celia Zall, in *J. Exper. Med.;* abstr. *Am. J. Pub. Health.*

MISCELLANY

BOOK REVIEW

Dental Mechanics, a Manual for Students and Junior Practitioners. By E. Lloyd-Williams, T.D., M.R.C.S., L.D.S.Eng., L.R.C.P. Lond., L.S.A., Lieut-Colonel R.A.M.C. (T. A.), retired. Late Senior Dental Surgeon, Westminster Hospital, and Senior Dental Surgeon and Lecturer on Dental Mechanics, Royal Dental Hospital of London. 253 pages; price, 5 shillings net. Published by John Bale, Sons & Danielsson, Ltd., London.

The author modestly claims that this manual is suggestive rather than informative, and it is intended to express for the most part the author's own views and to describe his methods. It is, therefore, made as practical as possible, and many little useful hints are accordingly conveyed to the reader.

The author will find very many of the men who are interested in bridgework, and also those who are deep students of orthodontia refusing to accept his rather blunt reflection on these two special lines of work. If his deductions are correct, the fact stands out quite prominently that there has been much waste effort in developing bridgework and orthodontia to their present stage of growth, and with this dictum the majority of our profession will not agree. Possibly the author has not been fortunate enough to see these two specialties at their best.

EXCERPTS FROM THE ANNUAL REPORT OF THE SURGEON GENERAL, U. S. NAVY, 1930

Personnel: Through an increase from 174 to 186 officers during the period of this report, the Dental Corps has attained for the first time since the World War its full authorized strength. The present apportionment of one dental officer to each 630 personnel is not adequate to provide the dental service needed. A Dental Corps strength of 232 (one dental officer to 500 personnel) will be needed in order to make the dental service required available for the personnel of all naval activities.

Dental Division: During the past year the activities of this division have effected at various stations the consolidation of scattered dental units with resultant improvement in dental service and with considerable reduction in expenditure. Of interest in this connection has been the combining of the former three separate dental units of the navy yard, Philadelphia, into one large central dental department. The dental quarters at the Naval Academy have been enlarged and remodeled and this activity has been provided with increased personnel and modern equipment. Similar changes have been made in the dental departments of the naval hospitals at San Diego, and Mare Island, at the naval training stations at Hampton Roads, Great Lakes, and San Diego, and at the marine barracks, Parris Island, S. C. Despite restriction of authorization for prosthetic dental treatment to edentulous members of the active list, the demands of the personnel for this service are constantly increasing. During the year, prosthesis was furnished in 4,002 cases at naval activities, and authorized from civilian sources at Government expense in 181 cases. Five hundred and three requests for this type of treatment were disapproved because of the necessity of confining authorization to cases in urgent need of treatment. Numerous requests from ships and stations for the establishment or augmentation of dental service were received during the past year. A complete dental service for the personnel of the Navy and Marine Corps can be provided only through an increased dental officer complement. In annual and special reports for the past several years, the inadequacy of dental corps personnel has been stressed and legislation to effect a dental officer apportionment of one officer to each 500 of personnel has been recommended. Such legislation is again recommended.

United States Naval Medical School, Washington, D. C. Two classes of medical officers and two classes of dental officers, each of five months' duration, received instruction during the year. A total of twenty medical officers and ten dental officers attended these courses. The dental department has given two courses

of instruction to ten dental officers and to forty-two Hospital Corps men during the fiscal year 1930. The course for the dental officers was designed to give them a thorough understanding of all theories recently advanced in dentistry, with a review of late investigations concerning the prevention of dental caries and such scientific methods of surgical, operative and prosthetic dental technic as would constitute a postgraduate course of instruction similar or equal to that given in older institutions of dental education.

Dental Diseases and Conditions: The admission rate was 541 per hundred thousand for 1929, 652 for 1928 and 513 for 1927. Many patients are operated on or treated for conditions relating to the teeth without such an admission having been recorded. There were ninety-eight admissions for cases reported as complications of other diseases and conditions and 100 for disability reported as existing prior to enlistment. In this class, sixty-eight persons were invalided from the service, sixty-five of whom had the condition before enlistment. There were no deaths.

NEWS

Rhode Island State Society Officers: The officers of the Rhode Island State Dental Society for the ensuing year are: president, Philip A. Duffy, West Warwick; vice president, Edward F. Gill, Providence; treasurer, William J. McGovern, Cranston; secretary, Charles J. Smith, Providence; editor, Ambrose H. Lynch, Providence; librarian-curator, Morris Lebow, Providence.

Delaware State Society Officers: The newly elected officers of the Delaware State Dental Society are as follows: president, Walter O. Stack; vice president, Robert E. Price; treasurer, P. A. Traynor; secretary, J. Paul Wintrup, all of Wilmington.

Dr. Burkhart Honored: Harvey J. Burkhart, of Rochester, N. Y., director of the Rochester Dental Dispensary, has been made a commander of the Royal Order of Vasa by King Gustaf of Sweden in recognition of his work in connection with the gift of a dental clinic to the city of Stockholm by George Eastman, who was recently the recipient of a similar honor.

Paris Selects Site for Eastman Clinic: Back of Montmartre between the thickly settled sections called Clichy, St. Ouen and Les Epinettes, a plot of city land 3,000 square yards in extent has been chosen as the site of the million dollar dental clinic offered the city of Paris by George Eastman of Rochester, N. Y. Before the land can be formally allotted to the clinic, Mr. Eastman must approve the plan, and certain details of the contract between the donor and the city must be altered to meet the requirements of local legislation. An architect is busy on plans for the seventy-five chair establishment and the city council subcommittee is going forward with the preliminary plans. Though the clinic is a gift from Mr. Eastman, the city is to provide the land and the upkeep, the latter estimated at $120,000 a year. As in the London and Rome clinics, it is planned that once the Paris clinic is in running order, all American direction will be withdrawn and the entire management will be turned over to local authorities. No better part of Paris could have been chosen than the site offered by the council. The district is both populous and poor, an enormous semi-slum, with equally thickly settled suburbs just beyond the city limits and soon to be incorporated in a greater Paris.

Simplified Practice: The Division of Simplified Practice of the Bureau of Standards, Department of Commerce, has just announced the availability of the printed pamphlet on simplified practice recommendation No. 108-29 covering dental hypodermic needles. This simplification program has resulted in the elimination of seldom called for lengths of needles, and it is expected that those sizes retained will satisfy the normal requirements of the industry. Copies of this pamphlet may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 5 cents each.

It has been announced by the Division of Simplified Practice of the Bureau of Standards, Department of Commerce, that the simplified practice recommendation on packaging of dental plaster, investments and dental stones has received the required degree of acceptance by the industry and may now be considered as in effect. As a result of this simplification, the number of sizes of plaster have been reduced from twenty-two to three, or 13.6 per cent; and investments from twenty-six to thirteen, or 50 per cent.

DEATHS

Garnsey, C. A. P., Evanston, Ill.; died, February 3; aged 88. Dr. Garnsey was a veteran of the Civil War and perhaps the

oldest practicing dentist in Illinois, continuing in practice until recently. He began practice before his enlistment, and had practiced in Chicago and Evanston, the latter for the past thirty-five years.

Latimer, William Reid, Oakmont, Pa.; University of Pittsburgh, School of Dentistry, 1920; died, October 13; aged 35.

Schumaker, Claude A., Albuquerque, N. M.; University of Pittsburgh, School of Dentistry, 1916; died of pneumonia, January 7; aged 37.

Smith, Irvin B., Washington, D. C.; Pennsylvania College of Dental Surgery, 1890; died, December 16; aged 61. Dr. Smith retired from active practice several years ago.

ASSOCIATION NEWS

STATE SOCIETY OFFICERS' CONFERENCE

A very satisfactory conference of the state society officers was held, February 1, at the recently purchased home of the Association. It seemed especially fitting that the initiation be made in this manner for it enabled the officers from the various states to see what was being accomplished in further promoting the stability of the Association.

The conference was better attended, from both the standpoint of actual members and number of states represented, than any held in the past; which seems to point to the increasing popularity of this system of getting representatives together from all corners of the United States. All of these men have the good of dentistry at heart and are devoting much of their time and effort in its interest. They have their problems to face and are anxious to better themselves so that they can accomplish more for the profession. They have found that this conference is a "clearing house" of problems and ideas and the earnest discussions of mooted questions is of great benefit to everybody. The following record of attendance is ample evidence of the interest manifested:

Alabama	1
Arkansas	5
California	1
Colorado	1
Connecticut	2
Delaware	1
District of Columbia	5
Florida	1
Georgia	3
Illinois	7
Indiana	3
Iowa	8
Kansas	4
Massachusetts	3
Michigan	2
Minnesota	4
Montana	1
Missouri	8
Nebraska	4
New Jersey	3
New York	5
Ohio	6
Oklahoma	2
Pennsylvania	5
South Dakota	1
Tennessee	2
Texas	1
Utah	2
Washington	2
Wisconsin	3
West Virginia	1
Wyoming	1

The following program shows the type of papers given at the conference: "A Survey of the Situation," "The Seventy-third Annual Session of the American Dental Association," "1931 Clinics," "The State Secretary," "The Smaller Dental Associations," "The Selection or Election of Delegates to the A. D. A. Meetings," "Lay Publicity," and "Coordinating the Activities of State Organizations with the American Dental Association or Local Components."

In addition to these prepared papers, there was open discussion on the following questions: "How to Interest Nonmembers in the A. D. A.," "Exhibits in Connection with State Meetings," and "Will the Use of Commercial Financing of Professional Bills Be to Our Advantage?"

Board of Trustees

The annual meeting of the Board of Trustees was held February 2 and 3, with all members present.

Council on Dental Therapeutics

The Council on Dental Therapeutics met, January 30 and 31, to review the work done in the field of dental therapeutics and to formulate plans for its future program.

Relief Fund Receipts

Contributions to the Relief Fund, to date, continue to exceed the receipts of any previous year. The total recorded January 31 was $16,990.46, an amount several hundred dollars in excess of the amount received up to January 31 of last year.

Extract From the Administrative By-Laws

The following extract from the Administrative By-Laws of the Association, Chap. I, Sec. 3, is self-explanatory:

"Sixty (60) days after January 1, the General Secretary shall drop from the membership roll the names of all whose dues for the current year shall not have been received."

It will therefore be necessary to discontinue mailing THE JOURNAL to those members who are affected by the foregoing regulation. THIS IS THE LAST ISSUE YOU WILL RECEIVE UNLESS YOU HAVE PAID YOUR 1931 DUES.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, Memphis, Tenn., Oct. 19-23, 1931.

American Association of Dental Schools, Memphis, Tenn., March 23-25, 1931.

American Board of Orthodontia, St. Louis, Mo., April 20, 1931.

American Dental Hygienists' Association, Memphis, Tenn., Oct. 19-23, 1931.

American Dental Society of Europe, Paris, France, July 29-August 1, 1931.

American Society of Orthodontists, St. Louis, Mo., April 21-24, 1931.

International Association of Dental Research, Memphis, Tenn., March 21-22, 1931.

International Dental Congress, Paris, France, Aug. 3-8, 1931.

International Orthodontic Congress, London, July 20-24, 1931.

International Stomatologic Congress, Budapest, Sept. 2-7, 1931.

Ontario Dental Association, Toronto, May 26-29, 1931.

Central Pennsylvania Dental Society, Johnstown, March 2-4.

Committee on Costs of Medical Care, Washington, D. C., September 17-24.

New York Society of Orthodontists, New York City, March 11.

Northern Ohio Dental Association, Cleveland, June 1-4.

St. Louis Study Club of Dentistry, March 25.

Society for Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

Southern Academy of Periodontology, Atlanta, Ga., March 9.

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

March

Minnesota, at Minneapolis (4-6).

April

Alabama, at Mobile (14-16).
California State, at San Francisco (8-10).
Connecticut, at Hartford (28-30).
Kansas, at Hutchinson (27-29).
Kentucky, at Lexington (6-8).
Louisiana, at New Orleans (23-25).
Michigan, at Detroit (27-29).
Montana, at Helena (16-18).
New Jersey, at Atlantic City (15-17).
Oklahoma, at Oklahoma City (21-23).
Tennessee, at Nashville (21-24).

May

Illinois, at Peoria (12-14).
Indiana, at Indianapolis (18-20).
Iowa, at Des Moines (5-7).
Maryland, at Baltimore (4-6).
Massachusetts, at Boston (4-7).
Missouri, at Kansas City (25-29).
Nebraska, at Omaha (18-21).
New York, at New York City (12-15).
North Carolina, at Winston-Salem (4-6).
North Dakota, at Fargo (12-14).
Pennsylvania, at Pittsburgh (5-7).
South Carolina, at Columbia (7-8).
South Dakota, at Huron (11-12).
Texas, at Houston (12-15).
Vermont, at Burlington (20-22).
Virginia, at Old Point Comfort (11-13).
West Virginia, at Huntington (18-20).

June

Arkansas, at Little Rock (1-3).
California Southern, at Los Angeles (8-13).
Georgia, at Atlanta (10-12).
Maine, at South Poland (18-20).

Mississippi, at Gulfport (4-6).

Nevada, at Reno (6).

Oregon, at Portland (17-20).

Washington, at Bellingham (June 30-July 1).

Wisconsin, at Milwaukee (9-11).

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, May 23; at Los Angeles, June 20. Bert Boyd, Secretary, 610 S. Broadway, Los Angeles.

Colorado, at Denver, June 2-6. Z. T. Roberts, Secretary, 810 Metropolitan Bldg., Denver.

Iowa, at Iowa City, May 25-28. Hardy F. Pool, Secretary, Mason City.

Indiana, at Indianapolis, June 15. J. M. Hale, Secretary, Mt. Vernon.

Kentucky, at Louisville, June 5-10. Robert L. Sprau, Secretary, 970 Baxter Ave., Louisville.

Maine, at Augusta, June 22-24. Alton H. Swett, Secretary, 192 State St., Portland.

New Jersey, at Trenton, June 29-July 4. John C. Forsyth, Secretary, 148 W. State St., Trenton.

AMERICAN ASSOCIATION OF DENTAL SCHOOLS; INTERNATIONAL ASSOCIATION OF DENTAL RESEARCH

All arrangements, including an interesting business program, have been made for the conventions in Memphis of the International Association of Dental Research and the American Association of Dental Schools. The first will be held March 21 and 22 and the second, March 23-25. Hotel Peabody has been designated as headquarters and the business sessions will be held there. Unusual problems are faced this year by the members of both organizations and it is desirable that the maximum possible attendance be had at these two meetings.

R. S. VINSANT, *Sec'y-Treas.*
American Association of Dental Schools,
716 Union Ave.,
Memphis, Tenn.

KENTUCKY STATE DENTAL ASSOCIATION

The sixty-second annual meeting of the Kentucky State Dental Association will be held, April 6-8, at Lexington.

J. H. FULLENWIDER, *Secretary,*
1101 Heyburn Bldg.,
Louisville.

IOWA BOARD OF DENTAL EXAMINERS

The next examination of applicants to practice dentistry in Iowa will be held at the State University of Iowa College of Dentistry, Iowa City, May 25-28. Applications properly executed, together with college diploma and fee of $25, must be filed with the state department of health at least fifteen days prior to date of examination.

HARDY F. POOL, *Secretary,*
Mason City.

ARKANSAS STATE DENTAL ASSOCIATION

The next meeting of the Arkansas State Dental Association will be held June 1-3.

IRVIN M. STERNBERG, *Secretary,*
Merchants Nat. Bank Bldg.,
Fort Smith.

MISSISSIPPI DENTAL ASSOCIATION

The Mississippi Dental Association will hold its annual meeting at Gulfport, June 4-6. All ethical dentists are invited.

A. S. HOPKINS, *Executive Committeeman,*
Gulfport.

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

The Board of Dental Examiners of the State of California will conduct examinations in San Francisco beginning May 23, and in Los Angeles beginning June 20. The credentials of all applicants must be in the office of the secretary of the board at least twenty days prior to the above mentioned dates. For particulars, address

BERT BOYD, *Secretary,*
610 South Broadway,
Los Angeles.

COLORADO STATE BOARD OF DENTAL EXAMINERS

The Colorado State Board of Dental Examiners will meet for their regular semi-

annual June examination in Denver, June 2-6. For further information, apply to

Z. T. ROBERTS, *Secretary*,
810 Metropolitan Bldg.,
Denver.

EASTERN ASSOCIATION OF GRADUATES OF THE ANGLE SCHOOL OF ORTHODONTIA

The annual meeting of the Eastern Association of Graduates of the Angle School of Orthodontia will be held, Monday and Tuesday, May 4-5, at the Vanderbilt Hotel, Park Ave. and Thirty-Fourth St., New York City.

E. SANTLEY BUTLER, *Secretary*,
576 Fifth Ave.,
New York City.

AMERICAN SOCIETY OF ORTHODONTISTS

The American Society of Orthodontists will hold its annual meeting in St. Louis, April 21-24, at Hotel Jefferson, Twelfth and Locust streets. Both local dentists who are members of the American Dental Association and physicians are invited to attend these sessions. Admission badges can be secured from the secretary at the time of the meeting.

H. C. POLLOCK,
4482 Washington Blvd.,
St. Louis, Mo.

DENTAL INTERN AT LENOX HILL HOSPITAL

The position of dental intern at the Lenox Hill Hospital will be vacant September 1. The term of service is one year, with full maintenance. Apply in writing not later than April 1 to

GEORGE F. SAUER, *Superintendent*,
112 E. Seventy-Seventh St.
New York City.

INTERNSHIP AT GEORGETOWN UNIVERSITY HOSPITAL

Applications for the dental internship at Georgetown University Hospital, Washington, D. C., should be sent to the Chief of the Dental and Oral Surgery Dept., Georgetown University Hospital, on or before June 1. The vacancy will occur July 1 and the internship is for one year.

DANIEL F. LYNCH,
1149 Sixteenth St., NW,
Washington, D. C.

REHWINKEL DENTAL SOCIETY (OHIO)

The Rehwinkel Dental Society will hold an all day and evening meeting at the Masonic Temple, Chillicothe, Ohio, March 28. The Ohio State officials and other essayists and clinicians will participate. All ethical dentists are cordially invited.

WILLIAM G. HAMM, *Sec'y-Treas.*,
19 S. Paint St.,
Chillicothe.

DENTIST FOR OVERSEAS SERVICE

An opening for a dentist for overseas service is announced by the American Board of Commissioners for Foreign Missions, 14 Beacon St., Boston, Mass. The dentist, a man, must enlist for three years' work in Dondi, West Central Africa. The secretaries of the Board list the qualifications as "good health, common sense, compatability, a cheerful spirit, a sense of humor and a single hearted devotion to Christ and his cause, which means a sympathetic appreciation of other races and faiths."

GEORGIA DENTAL HYGIENIST ASSOCIATION

The Georgia State Dental Association will hold its annual meeting June 10-11, at the Biltmore Hotel, Atlanta.

LOUIS HALL, *Secretary*,
Medical Arts Bldg.,
Atlanta.

NORTHERN JERSEY DENTAL ASSISTANTS ASSOCIATION

The Northern New Jersey Dental Assistants Association meets every third Tuesday of the month.

(MRS.) W. ELLOR, *President*,
347 Belleville Ave.,
Bloomfield.

CALIFORNIA DENTAL HYGIENISTS' ASSOCIATION

The California Dental Hygienists' Association will hold its annual meeting, April 9-10, at the Hotel Francis, San Francisco.

WEALTHY M. FALK, *Secretary,*
708 American Trust Bldg.,
San Jose.

STATE BOARD OF REGISTRATION AND EXAMINATION IN DENTISTRY OF NEW JERSEY

The State Board of Registration and Examination in Dentistry of New Jersey will hold its regular examinations at Trenton, commencing Monday, June 29, and continuing for five days thereafter. The examination fee is $25.00; reexamination fee, $10.00. Practical tests required: Insertion of a gold filling in cavity of class 2, 3 or 4 type, cavity to be of fair size and reasonably difficult to be acceptable and the candidate to furnish his own patient; taking of impression, bite, selection of teeth, articulation and trial denture, the candidate to furnish his own patient; practical examination in mouth diagnosis.

Attention is invited to the following quotation from the dental law of New Jersey: "Applicant shall present to said board a certificate from the commissioner of education of this state, showing that before entering a dental college, he or she had obtained an academic education consisting of a four-year course of study in an approved high school, or the equivalent thereof." In accordance with this law, the secretary will issue application blanks only on presentation of the required certificate from the Commissioner of Education, State House, Trenton.

Application must be filed complete ten days before the date of examinations (June 19, 1931).

Address all communications for further particulars to

JOHN C. FORSYTH, *Secretary,*
148 W. State St.,
Trenton.

THE NEW JERSEY STATE DENTAL SOCIETY

The sixty-first annual meeting of the New Jersey State Dental Society will be held in the Hotel Chelsea, Atlantic City, April 15-17. E. J. H. Schneider, 806 Clinton Ave., Newark, should be consulted for exhibit space and E. W. Roberts, 657 Haddon Ave., Collingswood, for clinical data. New Jersey welcomes all accredited visitors. For general information, address:

F. K. HEAZELTON, *Secretary,*
223 East Hanover St.,
Trenton.

NORTHERN OHIO DENTAL ASSOCIATION, CLEVELAND, OHIO

The seventy-fourth annual meeting of the Northern Ohio Dental Association will be held at Hotel Winton, Cleveland, June 1-4. These meetings, as in the past, will be featured by teaching clinics; that is, the essayist will also give a practical demonstration in the form of a clinic each afternoon. The following out-of-town men will appear on the program: W. J. Charters, Des Moines, Iowa: "Tooth Brush Manipulation"; F. Blaine Rhobotham, Chicago, Ill.: "Children's Dentistry"; Howard C. Miller, Chicago, Ill.: "Oral Surgery"; Arthur J. Cramp, Chicago, Ill.: "Patent Drugs"; Stanley D. Tylman, Chicago, Ill.: "Fixed Bridgework"; Milton T. Hanke, Chicago, Ill.: "Diet"; M. M. DeVan, Philadelphia, Pa.: "Full Dentures." An invitation is extended all ethical dentists.

WALTER S. SARGEANT, *Publicity Committee,*
807 Nicholas Bldg.,
Toledo.

ONTARIO DENTAL ASSOCIATION

The annual convention of the Ontario (Canada) Dental Association will be held at the Royal York Hotel, Toronto, May 26-29. A program of essays and clinics has been prepared. Ethical dentists of provinces of Canada outside of Ontario and from the United States are invited to attend as guests of the Ontario Society.

FRED J. CONBOY, *Sec'y-Treas.,*
1442A Yonge Street,
Toronto.

TRANSACTIONS OF THE 1931 MIDWINTER MEETING CHICAGO DENTAL SOCIETY

As stated in the preliminary program, we are endeavoring this year to publish the complete transactions of the Midwinter meeting at cost. In order to proceed with this volume, it will be necessary to have a sufficient number of subscribers to make the plan

workable. At the present time we do not know the exact cost of such a publication but with the cooperation of THE JOURNAL, we feel that the cost will be reduced very materially.

We are asking each subscriber to accompany his order with $4.00, payable to the Chicago Dental Society. This money will be kept by the secretary of the Chicago Dental Society until (1) we see whether a sufficient number of requests has been received to warrant the publication; (2) whether this amount is sufficient to cover its cost. (3) If transactions are published, we guarantee the cost not to exceed $5.00; (4) if they are not published, the money will be refunded to the subscribers.

You may subscribe for these transactions by writing direct to the Secretary of the Chicago Dental Society, 185 N. Wabash Ave., Chicago, Ill.

HOWARD C. MILLER, *Secretary.*

ALUMNI ASSOCIATION NEW YORK UNIVERSITY COLLEGE OF DENTISTRY

Alumni Day of the New York University College of Dentistry will be held Friday, April 17, at the dental school building, 209 East 23rd St. All graduates of the dental school, whether members of the alumni association or not, are invited to attend. Reservations for the dinner may be made by sending name, address, year of graduation and check for $5 to Waite A. Cotton, 241 West 71st Street.

SAMUEL CHARLES MILLER, *Secretary.*

ALUMNI SOCIETY OF PHILADELPHIA DENTAL COLLEGE AND THE DENTAL SCHOOL OF TEMPLE UNIVERSITY

The sixty-eighth annual meeting of the Alumni Society of the Philadelphia Dental College and the Dental School of Temple University will be held at the college, 18th and Spring Garden streets, Philadelphia, Wednesday, May 20.

JOHN WALLACE FORBES, *Chairman,*
Journal and Press Committee.

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1930-1931

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